THE

# ELECTRICAL REVIEW.

VOL. LVI. APRIL 14, 1905. No. 1,429.

## ELECTRICAL REVIEW.

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## ELECTRICITY IN MINES.

IN our issue of February 26th, 1904, we drew attention to the report and recommendations of the Committee appointed by the Home Office with regard to the use of electricity for lighting and power in coal mines. The Home Office has now issued a set of rules substantially the same as those recommended by the Committee. We reproduce them in this issue.

These rules, which are sub-divided into 11 sections, and in all number 56, are framed with a view to safeguarding against accidents due to electric shock, explosion, or fire.

As far as electric shock or fire are concerned no further rules are necessary than those which are insisted upon already by the Board of Trade and the Fire Insurance Companies, and it is consequently only those regulations which have to be observed as a safeguard against explosion upon which comment may be useful.

In our article, to which we refer above, we drew attention to the inadequacy of the Committee's report, inasmuch as while certain possible causes of accident were indicated, no strong recommendation as to the best means of averting disaster was made.

Mine installations, like all others, are not always in the hands of competent people, and unless explicit directions for the carrying out of the work are laid down, there is a considerable amount of uncertainty as to the result.

It is not necessary for us to point out that fire damp, like other explosive gases, is only ignited on a certain high temperature being reached, and that the probability of accident in the absence of a spark or flame would be comparatively small. It is also true that it is easier and safer to suppress the cause than to obviate or minimise the effect. A natural consequence is that perfect safety in the use of electricity in mines as regards explosions can only be ensured by the use of sparkless machinery.

Gases, whether explosive or not, have the peculiarity of permeating through every niche or crevice, no matter how small, and the enclosed motor cannot be made absolutely gas proof.

We hear much about the sparkless commutation of direct current machines, but the expression is only one of degree. Wherever there is a commutator there is some sparking, and one spark is all that is necessary to explode a gaseous mixture.

To our mind, semi-enclosed motors with the openings covered completely over by a fine gauze network are safer than the so-called enclosed motors. The latter are dust proof, but not gas proof.

We would, however, prefer to use motors without sparking commutators. Without holding a brief on behalf of induction motors, we strongly advocate them for mining operations. Not only are they free from sparking, but they are stronger mechanically and better able to stand the rough usage to which mining machinery is particularly liable.

In the transmission of power by alternating currents, whether at low pressure or high, there is nothing which renders it inferior to direct current, with the single exception of the power factor, the only effect of which is to slightly increase the cost of the plant. In mining operations, however, the first cost of the plant should only receive consideration after the safety of the miners is secured, and we venture to assert that with alternating current motors worked normally, that is to say, not excessively loaded so as to cause a burn-out, the chances of an explosion are far less than with the best enclosed direct current motor made.

Had the rules, which we are now criticising, insisted upon alternating current for power purposes in coal mines, we could not have objected.

In other respects the rules are carefully and admirably drawn up. Diligent and frequent supervision and overhauling is required, with records of periodic inspections.

Nothing is left to chance, except the choice of the machinery. This is left open, and mine-owners and engineers can use their own discretion or indiscretion, provided that afterwards certain precautions are taken.

If explosions are to be avoided, the safest way is to keep sparks away from the gas, not to take sparks there, and then to endeavour to prevent their customary effect.

Perhaps, in due course, a supplementary set of rules will be forthcoming, in which the "prevention is better than cure" principle will be recognised.

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Postal Telegraph Clerks.

THE annual conference of the Postal Telegraph Clerks' Association was held in London last week, amongst those present at the opening of the conference being Sir Albert Rollit and three other members of Parliament. The speakers at the meetings found no difficulty in explaining what was the duty of the Postmaster-General in regard to the payment of the staff, or in fixing what should be the minimum wages for any member. A certain amount of more or less wild, uncontrolled talk is inevitable at such gatherings, but it was hardly to be expected that anyone of the political and practical experience of Sir Albert Rollit, after making the sensible, if obvious remark, that "one of the chief conditions of a good and healthy service was contentment in the service itself" should follow it with the further statement, "and above all, that the first charge upon a surplus revenue was in payment properly and reasonably of those who helped to earn it." Such remarks are, of course, followed by "loud applause." Are they made for any other purpose? Does the surplus of the postal service come from the workers or the public? Would the staff be content to work for half wages if the postal rate were reduced from 1d. to ½d.? Members of Parliament should be more consistent. Sir Albert Rollit is champion of postal servants in one capacity, and director of the National Telephone Co. in another capacity. In its "Life and Labour" column (for which the editor disclaims responsibility), the *Daily News* asks whether the division of the National Telephone "spoils" between those who worked and those who invested is quite fair? The arguments, of course, are incomplete and unsound in either case. Both must be judged on commercial lines, free from class prejudices, or cheap efforts at "loud applause."

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Technical Training: A Teacher's Views.

AT a meeting of the Association of Teachers in Technical Institutes held on March 27th at the Regent Street Polytechnic, London, the chairman of the Association, Mr. W. J. Lineham, M.I.C.E., M.I.M.E., gave an address, from a teacher's point of view, on Technical Training.

Mr. Lineham is so well known to us, both as a successful teacher and as an author whose books are recognised textbooks in our technical schools, that we are compelled to give considerable weight to his opinion on the subject. He says that "all education may be approached from four points of view—those of (1) the scholar and parent, (2) the teacher, (3) the British public generally, and (4) the administrator."

Will Mr. Lineham forgive us if we cut all these classes down to one, viz., the benefit of the scholar, because all the others are simply coroliaries?

The aim, we take it, of technical education, is to produce the greatest results in each individual scholar with a minimum cost to the parent, a minimum trouble to the teacher, and a maximum usefulness to the British public generally. The administrator is of no account. No doubt Mr. Lineham could put his views into similar language, since the results to each individual scholar are of paramount importance.

What we have to consider, then, is the best means of benefiting each scholar most.

We have here to assume, of course, that the scholar has some ability and is anxious to learn. Not all scholars are anxious to learn, and it may not be out of place to indicate here that parents will have done their share of the work if they ensure by any means, forcible or otherwise, that their children are imbued with a strong desire to acquire knowledge.

Assuming, then, that the students are in earnest, what is the best way of helping them to obtain a technical, useful education, which will enable them to earn their living in any branch of industry which they may choose, and to become so efficient as to render a service to the British public, by becoming more efficient as regards technique than their foreign neighbours?

Everybody now knows that in every pursuit there is a theoretical and a practical side, and that to be proficient the two must be mixed together in suitable amounts.

Until recently, it has been the custom to get the combination in two doses, one practical and the other theoretical, it being a matter of choice which dose was applied first, although opinion generally favoured the practical dose first, since a primary theoretical dose conduced to indigestion and want of assimilation of the subsequent practical dose.

Latterly, opinion has been in the direction of a more intimate intermingling of the doses, and of this there are, as Mr. Lineham indicates, the thick and thin sandwiches. One must not drive the analogy between the digestive organs and the mental organs too far, though there is no doubt a great similarity. Our knowledge of the physical organisms is much more extended and accurate than is our information regarding the mind. Almost without exception we know that certain poisons administered in certain doses at certain intervals will produce death, but we cannot predict the results if information is told—we will not say imparted, because that means told and understood—in certain amounts and at certain intervals. The reasons for this are the great similarity in the physical constitution of all human beings, and, in general, the great dissimilarity in mental powers.

We can only talk about the average individual whose receptive powers are not of an extraordinary order of merit. For such—and here we can speak, like Mr. Lineham, with the authority gained by experience—the thick sandwich has the better chance, since there is time for each layer to have some effect,and the application can be made under the most favourable circumstances.

We are not of opinion that a large practical dose during the brightest hours of the day, followed by a small theoretical dose during the weary evening time, will produce good theoretical results. We have seen students, earnest students, killed by the overdose, and others dying in a theoretical muddle.

As Mr. Lineham points out, the thick sandwich system is hard to realise, but we are convinced that it is the proper one to advocate.

We have, of course, to consider the object each individual student has in view. If he happens to be born of well-to-do parents and is destined to become an employer, the thick sandwich can profitably have the thicker layer composed of theory. An employer should know how to do a thing, and be able to easily distinguish between good and bad or indifferent work, but he does not need that intimate practical knowledge which can only be attained by hard, frequent, and long practice.

On the other hand, the prospective skilled artisan should have a thick practical layer, with a layer of theory sufficiently thick to enable him to comprehend the reason for each process, so as to throw intelligence into his work. If he starts with a fair equipment of theory, he will add to it as time goes on, and fit himself for more responsible positions *if his general character merits a position of trust.*

Education is a great and potent factor, but it avails but little unless accompanied by that all-important factor called character.

## ELECTRIC WINDING ENGINE OF THE TIREMANDE MINE.

By DR. A. GRADENWITZ.

The winding engine described below was constructed by the Elektrizitäts Aktien Gesellschaft, formerly W. Lahmeyer & Co., Frankfurt o/M., Germany, and before being installed, was exhibited in working order at the Mining Exhibition held last year in Arras, near Lille, France. The engine is designed for winding 105 tons of coal per hour, from a depth of 400 m., at a speed of 8 m. per second ; this entails 48 runs per hour, with an effective load of 2,200 kg., 60 seconds hauling time and 15 seconds interval between each two runs.

The whole engine has been mounted direct on the winding tower (fig. 1) above the pit, at a height of 21 m. from the ground. This arrangement was chosen in order to save space, and in order to do away with special machine rooms, necessitating extensive and costly foundations. The winding tower consists mainly of four stays, braced by lattice-work girders, so that its feet form a square of about 9 m. side, the weight of the tower (120 tons) being not much above that of the ordinary arrangement. The floor of the engine room is 6·7 m. in breadth and 8·6 m. in length, a projecting platform (2·6 × 3 m.) being set apart for the driver, who is able to control, from his post, all the measuring instruments, checking and safety devices and working levers (fig. 2). Another floor is provided 4·2 m. below the engine-room floor, supporting the guide pulley, as well as the controlling device for the depth indicator and the controller, the latter being enclosed in a glass case, arranged between the two floors.

The winding engine is of the Koepe type, the main pulley being 4 m. in diameter. In order to obtain a distance of 1·1 m. between the axes of the cages, the guide pulley has been placed 4 m. below the main pulley and in the same vertical plane, the guide pulley also being 4 m. in diameter. The round steel cable is 35 mm. in diameter, and the floors of the two cages are connected by a balancing cable.

Each pulley is fitted with two grooves, one of which is used when changing the cable. The Koepe main pulley is mounted on a shaft and two bearings, and is directly coupled to two direct-current motors giving an aggregate maximum output of 500 H.P.; the motors being mounted respectively to the right and left of the pulley. In order to obtain a speed of the cable as high as 8 m. per second, the motors run at 38 r.p.m. during the winding operation, and at 19 r.p.m. during the intervals, while in the case of an inspection of the pit the speed is reduced to $\frac{3}{4}$ r.p.m., corresponding to a speed of cable of only

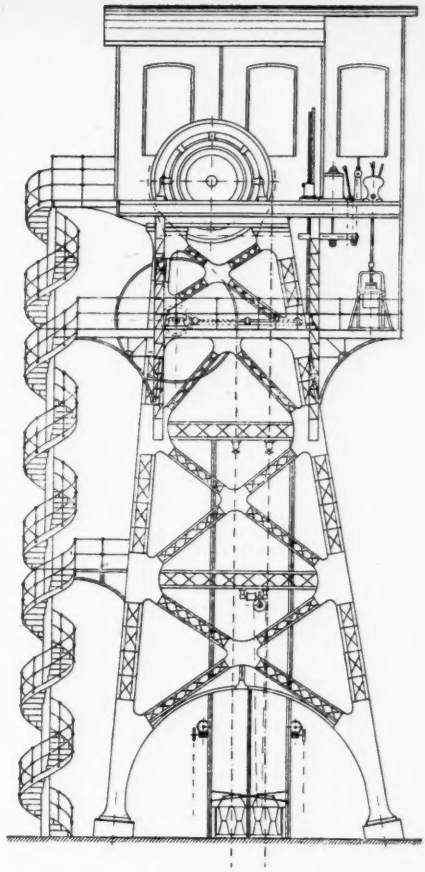

Fig. 1.—General Arrangement of Winding Tower.

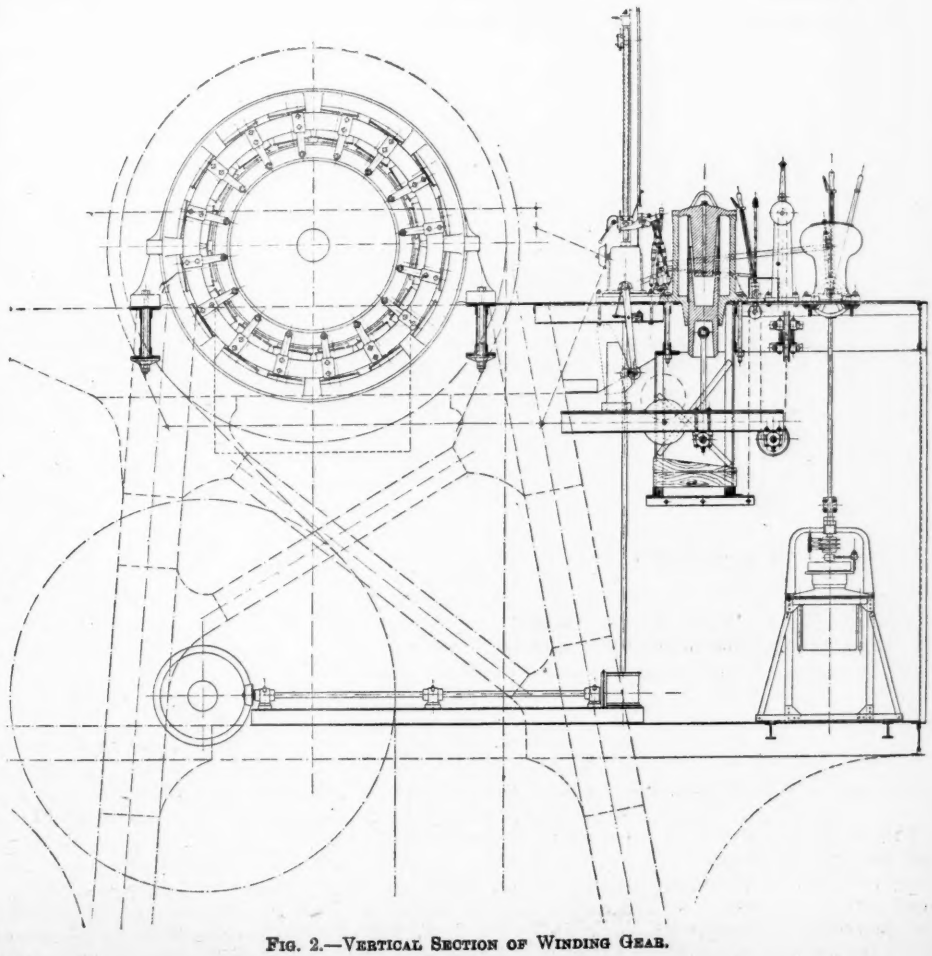

Fig. 2.—Vertical Section of Winding Gear.

0·25 m. per second. The maximum power required in starting is about 600 H.P., falling to 300 H.P. in normal working, and to zero during the stoppages.

In order to avoid any troublesome effects arising from these variations of load on the generating plant, a buffer set has been installed in the power station, serving at the same time for starting and controlling the engine, and for equalising the load of the power station. This buffer set was constructed according to recent patents of the Lahmeyer Co.; it includes a starting dynamo A M (see fig. 3), the so-called buffer motor P and the booster Z, these three machines being mounted on one shaft, fitted with a fly-wheel S, as shown in fig. 4.

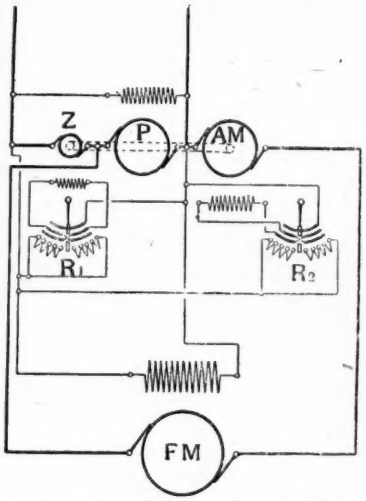


Fig. 3.—Connections of Buffer Set.

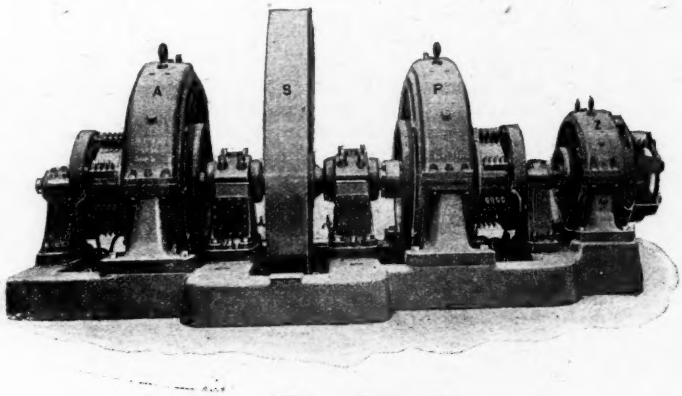


Fig. 4.—Buffer Set.

While the winding motors F M are at rest, the starting dynamo A M, which is connected in series with the line, produces the same voltage as the main generating plant, but in the opposite direction, so that the pressure at the terminals of the winding motors is *nil*. On starting, the excitation of the starting dynamo is diminished, thus augmenting the pressure at the terminals of the winding motors, so as to cause the latter to start. Their speed will increase according as the excitation of the starting dynamo is reduced. When this becomes zero, the speed of the cable will have reached half its normal value. The excitation of the starting dynamo is next reversed, so that its voltage is added to the voltage of the line, and the aggregate voltage reaches 1,050, when the speed of the cable attains its maximum.

From the above, it is seen that the regulation is effected exclusively in the excitation circuit of the starting dynamo—that is to say, in a circuit traversed by a current of trifling value.

The regulator with its resistance (fig. 5) resembles in shape a controller, and is fixed on the guide pulley floor. It is controlled by the working lever, fitted on the upper floor, which is connected mechanically to the controller.

The booster Z is connected in series with the buffer motor, and includes a regulator in its excitation circuit. From the diagram of connections (fig. 6), it will be seen that if the voltage of the booster is added to the voltage of the line, the pressure applied to the terminals of the buffer motor increases, so that the latter revolves at a higher speed. If, on the other hand, the voltage of the booster is deducted from that of the line, the buffer motor must rotate more slowly, intermediate speed values being obtained by adjusting the regulator on the intermediate contact plugs. A variation as high as 30 per cent. is thus obtained in the speed of the motor, and accordingly in that of the buffer set. It will be evident that as the speed of the set decreases, the fly-wheel will assist the central station, whereas whilst the

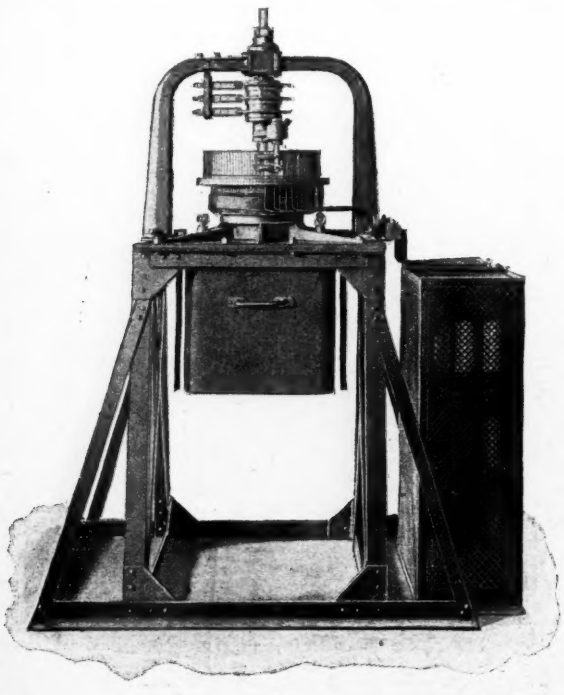

Fig 5.—Regulator and Resistance.

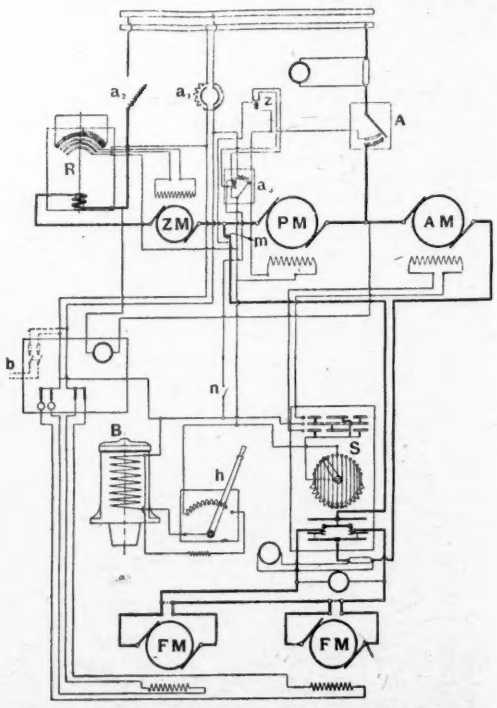


Fig. 6.—Complete Diagram of Connections.

speed augments, the fly-wheel is storing up energy derived from the generating station. The regulator (fig. 5) is made automatic by the addition of an electro-magnet, excited by the main current supplied by the central station; this device is shown in fig. 7. As soon as an increase in current strength occurs, the regulator will reduce the speed of the buffer set, while in the same way it augments the speed when the output begins to decrease. Thus the fly-

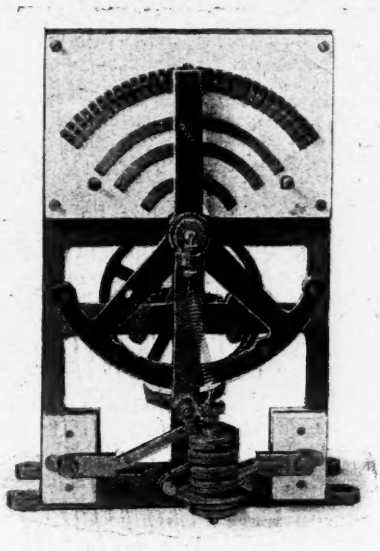

Fig. 7.—Automatic Regulator to Control Speed of Flywheel.

wheel energy is utilized to keep the output of the generating station constant, independently of the position of the winding motor.

In order to be able to stop the buffer set, an electro-mechanical brake has been provided, working automatically in the event of a defect occurring in the buffer set. The big brakes of the winding engine are double-shoe brakes, acting on the Koepe main pulley, and being generally applied through a counterweight. This is lifted by an electro-magnet, which is excited more or less strongly under the control of a regulator inserted into its circuit, and is dependent on a second

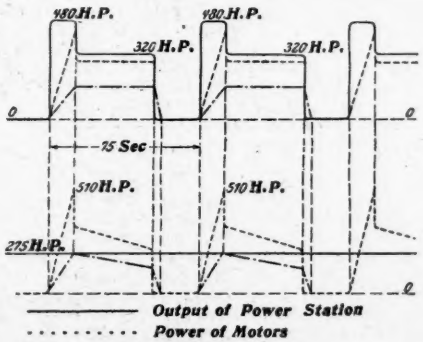


Fig. 8.—Speed and Power Diagram.

controlling lever (the brake lever). If the electro-magnet fails to work, a hand winch can be used instead up to the end of the wind, and until the electro-magnet has been repaired.

A depth indicator, recording the position of the cages, serves as a safety apparatus. In order to avoid any slip resulting in erroneous reading, it is actuated by the shaft of the guide pulley through the intermediary of rods and conical gears. This apparatus is mechanically connected with the starting lever. As the cage approaches the end of the haul, the indicator first gives a signal, when the controlling lever is thrown back automatically, and the brake also applied automatically. In case this apparatus were out of order, an electrical safety device is arranged stop the cage. This safety device does not break the total current, but merely the small current traversing the cores of the automatic device, which in turn cuts off the main current so as to demagnetise the electro-magnet of the brake gear and cause the counterweights of the latter to fall down.

In front of the driver is a third lever, the so-called safety lever, the least displacement of which cuts off the current, disengaging the counterweight of the brakes, so as to stop the machine almost instantaneously.

In order to preclude any injury to the machine due to a too abrupt starting, a set of automatic devices has been provided in connection with a time relay, allowing them to work only in case the overload lasts too long.

A Karlik speed meter has also been provided, actuated from the main shaft, and tracing the working diagram of the machine, which serves as a means of checking its behaviour.

The fluctuations in power supplied to the motors, power developed by the motors, and the speed of the latter are graphically shown in fig. 8.

All the parts of the engine have been designed for resisting the breaking load of the cables, that is, a load of 65,000 kg.

The writer is indebted for the foregoing particulars, as well as for the illustrations here reproduced, to the courtesy of the Lahmeyer Co., of Frankfort-on-Main.

## PARLIAMENTARY.

### Administrative County of London and District Electric Power Bill.

(*Continued from page 560.*)

At the opening of the proceedings on Wednesday last week, Mr. Balfour Browne, K.C., said that the competing companies were somewhat in doubt as to the exact intention of the promoters. If the primary object of the promoters was, as had been stated, the supply of electricity in bulk to authorised distributors, he was afraid that the opposition had misunderstood it. But he would like to know what was the exact position of the promoters. Would they supply anyone who asked them at a maximum price of 1½d.?

The Chairman thereupon asked Mr. Browne if he would withdraw his opposition if the promoters replied that they would limit themselves to the supply of the authorised distributors.

Mr. Balfour Browne replied that if they did so limit themselves, their Bill would not be worth having.

The Chairman: We must take the Bill as it is, and not merely what learned counsel says about it. He again asked Mr. Browne if he would cease to oppose.

Mr. Balfour Browne said that if the promoters would say that they would not supply any trade in the district, he believed that a large number of the petitioners would withdraw. In his opinion the clauses in the Bill would completely nullify the maximum prices in the schedule.

The discussion then dropped, and the hearing of the opposition of the Southwark Council was proceeded with.

Mr. Harrison, the borough electrical engineer, was called, and said that already there were four competitors in the district and they did not want a fifth. He admitted that the present charge for lighting was higher than the former charge for gas. It was less, he added, than the price paid by the Westminster Council to the electric lighting company.

Mr. Vesey Knox then mentioned that he appeared for the District Councils of Ilford, Bromley, Bexley, Beckenham, Dartford, Wimbledon, Chiswick, Twickenham, and the Corporation of Gravesend. He proposed to call a witness from each place.

Mr. Arthur P. Shaw, resident electrical engineer to the Ilford Council, said that both the tramways and the lighting undertaking of that authority were run at a profit. The total number of units generated and sold had shown a very great increase since the commencement. The estimate for the year ending March, 1905, showed a total of 2,400,000 units generated. At present they had 2,000 consumers for lighting and power, and practically supplied one house in six in the district. The works cost per unit sold had gone down from 1·33d. to 1d. Witness considered that it was the cost of distribution which was the most important item. At the end of last year the total number of motors connected was 50 with a horse power of 301. He considered that they supplied about half the horse power required in the district. The majority of the motors were small. The total revenue from power last year was over £1,000, but that bore only a small proportion to the energy supplied for lighting. The total revenue from the energy supplied both for lighting and power purposes was £22,000. The tramways of the Council showed a larger profit than the electric light undertaking, last year's profit being about £4,000. Witness handed in a table giving the above figures.

Cross-examined by the Hon. J. D. Fitzgerald, Witness was not sure that they would have saved anything by taking their power from a large power company. He had had some experience in

America, but was not aware that the American Government had issued a return showing which electric railways generated their own power and which took their power from a company.

Mr. J. W. Benton, clerk to the Ilford Council, was also called, and submitted a table showing the possible number of consumers of power in a number of parishes in Essex. In many of the places the population was less than one per acre, and the soil was of a marshy nature rendering the districts entirely unsuitable for development as residential districts.

Cross-examined by Mr. Honoratus Lloyd, K.C., who suggested that there were many sites on the banks of the river suitable for factories, Witness said that he did not consider that the sites could be so used, as they were very difficult to approach, and the land was very marshy. He admitted that there was at present no power supply in the districts.

Mr. McInnes, A.M.I.E.E., electrical engineer to the Corporation of Gravesend, said that that authority had spent some £12,000 on their electrical undertaking, and would shortly be extending their works to meet an increased demand. The works cost last year worked out at 1·94d. The chief consumer of power in the district was the tramway company. Up to the present the undertaking had resulted in a loss, but given time and no competition, they would be making a profit.

Cross-examined: The tramway company were under an agreement to take their supply from the Corporation for all time, subject to revision of prices every seven years. The price paid by the tramway company was 2d. per unit for the first 180,000, 1¾d. for the next 170,000, and 1½d. per unit afterwards. The average price last year was 1·79d.

Mr. Pember, M.I.E.E, resident electrical engineer to the Dartford Council, was then called, and stated that that Council commenced to supply in 1901. The capital outlay up to the present had been £36,957. The price charged for the supply of energy was 2½d. for power, and 7d. to 2d. for lighting. The number of power consumers was 80.

Mr. Tomlinson Lee, electrical engineer to the borough of Wimbledon, and Mr. Philip Dawson, for Dartford and Gravesend, were also called, the latter Witness putting in tables showing the possible cost to the local authorities if they took a supply from the promoters. Witness had in each case taken a duplicate main. Even if Dartford and Gravesend were supplied by one main, the cost would be greater than the present works cost of those authorities.

Mr. Hudson, chairman of the U.D.C. of Bexley, and chairman of the Tramway Committee of that authority, also gave evidence.

Mr. Vesey Knox then addressed the Committee, contending that under the Bill the purchase clauses with regard to the companies now purchaseable after a certain period by the local authorities, would become inoperative. Dealing with the authorities separately, he called the attention of the Committee to the extremely satisfactory position of Ilford. He admitted that many of the local authorities' undertakings showed considerable room for improvement, but it was to be hoped that by 1910 they would all be in as satisfactory a position as was Ilford. If the promoters had come to seek the powers in 1900 they might have had a case, because then the districts in the industrial area were not supplied, but now the local authorities had established their undertakings, and those undertakings were quite equal to the demand. If generating stations were abandoned and a supply taken from the promoters, he did not think it would be successful. There was also the personal note, for the engineer had his own station and was put upon his mettle to make it a success. That would be eliminated if he had only a distributing station to superintend. What the promoters really wanted to do was to get the whole of the area into their own hands. The inclusion of the various outside authorities would create a new kind of "water" London, and in the interests of local government that was not desirable.

Mr. R. S. Clease then addressed the Committee on behalf of Barking. The district was rapidly growing. For the year 1899-1900 the number of units supplied was 127,626, and this had increased until for last year the number was 633,000, which included lighting and power. The Council last year acquired a site on the river for a new generating station, and when this was erected the old station would be used for distributing. The Council would be able to supply all the power likely to be demanded. He contended that the competition of the promoters would spell nothing less than disaster; indeed, he would not call it competition, for the promoters would be able, in their own words, "to help the manufacturer to re-organise his works," a power which the Council did not possess.

Lord de la Zouche: But cannot you supply or lend the manufacturer plant?

Mr. Clease: No, my Lord; we can only supply energy, though we can, and do, give advice to customers.

Lord de la Zouche: But how about transforming plant?

Mr. Clease: That is not necessary; we supply direct into the works. Transforming is one of the disadvantages attaching to the promoters' case.

Mr. Clease, in conclusion, compared the promoters' scheme with an octopus which stretched its tentacles all over London and Greater London. "And when it has sucked our life-blood, what does it propose to do? It proposes to take our worthless carcase—at a price—and what price? Why, at practically old iron price; and, no doubt, then we shall be willing to get rid of it at any price." He suggested that the promoters should not be allowed to supply for lighting, and that the ordinary veto clause should be inserted in the Bill, if it passed. The local authorities had justified their existence as generators of electricity, in spite of the "big guns of the *Times* and the machine guns of the *Daily Mail*."

Mr. Sanders, on behalf of Islington, having addressed the Committee, the hearing adjourned.

On Thursday, April 6th, when Counsel for Kingston-upon-Thames addressed the Committee, Mr. Reader Harris, K.C., briefly stated the case for the opposition of the Councils of Ealing and Barnes. He said that both places were outside the industrial area, but were within the non-industrial area. The Bill offered them no benefit; they offered the Bill no benefit; and there was no precedent for including them in the area of supply. There were no factories in the district, and there were covenants prohibiting the erection of factories. The two railways in the district were the Metropolitan District and the Great Western; the former generated its own supply of energy, and when the latter was electrified it also would generate its own supply. If the Councils ever wanted a supply in bulk they could get it from the two companies at their very doors.

This concluded the opposition of the local authorities.

Mr. Balfour Browne, K.C., reverting to his statement made during the previous week, that in all probability a settlement would be come to between the promoters and the South Metropolitan Gas Co, said that he was sorry to say that no such agreement had been possible.

The Chairman of the Committee again expressed his intention of taking no part in any decision on this point, although he would remain in the chair.

Sir Geo. Livesey having been called, the Chairman elicited from the Hon. J. D. Fitzgerald that what the promoters really wanted to do was to run over the lines of the gas company at Greenwich for the purpose of getting the plant to their generating station. They would drop the proposed taking of land.

Mr. Balfour Browne objected that up to the present moment the gas company had been under the impression that the promoters wanted to take a piece of land which had been given by Parliament to the gas company. The running over the line was the result of the working of Mr. Fitzgerald's fertile imagination during the past few minutes.

Mr. Fitzgerald: I do not think you ought to say that.

Mr. Balfour Browne: Very well, I will withdraw everything about your fertile imagination.

Learned Counsel went on to say that had the gas company known that the taking of the land was not intended they would not have gone to the expense of opposing. He considered that his clients had been treated very unfairly.

The opposition of the electric supply companies was then continued.

Mr. J. Devonshire, director of the North Metropolitan Electric Power Supply Co., was called to speak of the progress made by that company with the erection of generating stations at Brimsdown and Hertford. Part of the company's area would come within the promoters' area, that part being the whole of Stoke Newington. His company had a contract with the Stoke Newington Council for a supply in bulk to the Council, and there were a number of years yet to run. Their opposition would be withdrawn if Stoke Newington were struck out of the Bill.

In cross-examination, the Hon J. D. Fitzgerald elicited from Witness that it was his opinion that it paid a local authority to get a supply from a company, and,

Mr. Moon, K.C., who had conducted the examination in chief, protested that Mr. Fitzgerald was converting witness into a witness for the promoters.

The Chairman said that the Committee wished to get all the information possible.

Mr. Roger Wallace, K.C., then addressed the Committee on behalf of the Kensington and Notting Hill Companies, asking that those districts should be excluded from the Bill, if it passed.

Mr. Bowden, managing director and engineer-in-chief of the South Metropolitan Electric Supply Co., was called, and said that his company had laid over 50 miles of high-tension mains, specially for power purposes. With the energy generated by his company it was only necessary to have static transformers, and these compared favourably with the rotary converters in the scheme of the promoters.

Major Cardew also gave evidence on behalf of the company.

Mr. C. P. Sparks, chief engineer to the County of London Electric Supply Co., said that that company supplied some 23 sq. miles in the metropolis, the total number of horse-power in motors connected with the company's mains at the end of last year having been 6,055 H.P. Orders for 2,000 H.P. had been received this year. There were in the area of his company, in all, 571 power consumers, the units sold last year having been 2,300,000. In his company's area north of the Thames, the horse-power connected per 1,000 head of the population was 37·2. In the southern area the figure was 15·7. The tendency, nowadays, was for large power-taking companies to remove from London; it was due to the high price of labour, the cost of land and the high rates and taxes. His company had 500 miles of mains laid.

On Friday, Mr. Sparks gave further evidence, putting in figures to show the increase of consumption for power purposes in the company's area. In 1900, 16 per cent. of the energy they supplied was for power last year it had risen to 32 per cent. By 1910 they would be supplying, he anticipated, 75 per cent. of the power in their area, and by that time the percentage of the supply for power would be 45. He considered that the Curtis turbines were more suitable for generating plant than the large units proposed by the promoters. His company had on order several Curtis turbines of 1,500 KW. capacity.

Cross-examined by the Hon. J. D. Fitzgerald: His company would be able to supply quite as cheaply as the promoters proposed to do if the restrictions upon the company were removed. Witness admitted that, under his company's provisional order, a consumer would have to pay for any main of a greater length than 60 ft. from the company's main—that was if the consumer was within 50 yards of the main. If the consumer was further than 50 yards away

from the main, he could not get a supply if the company refused to serve him.

The Chairman remarked that the Committee had been under the impression that the companies were bound to supply anyone in their district.

Mr. Balfour Browne, K.C., explained that if two consumers required a main to be laid to within 50 yards of their premises, the company would be compelled to lay it, providing that the two consumers were willing to pay 20 per cent. of the cost of the laying of the main. In cross-examination, witness said that 20 per cent. was generally taken out in the supply.

Mr. Renwick, secretary to the County of London Co., said that the company had expended £1,500,000. Their borrowing powers were £800,000, and of that sum £756,666 had been paid up. Witness produced a number of the canvassing books of the company in support of his statement that the company had pushed their business. They also gave motors to small consumers with the object of educating them to the use of electric power.

Mr. Fitzgerald in cross-examining witness, remarked that his company seemed to have canvassed very successfully, as they had succeeded in getting quite a number of consumers to take power at 2d. per unit.

Mr. Balfour Browne, K.C., addressing the Committee for the opposing companies, said the Bill sinned against the whole of the past legislation on the subject. The case had been launched against his clients by the promoters making certain allegations against the London companies. In order to meet that, they had shown the very large capital that had been expended by the London companies to provide for and meet the wishes of the public. They had tried also to show that the provision they had made was sufficient to meet all the public demands, not only for lighting with which they began, but for power which they had been cultivating recently. In fact, they had shown their ability to meet all demands with one exception—viz., traction. There was a difficulty in supplying power for traction in that a company could not supply power for use outside its district, and, as his Lordship would remember, in several of the Power Bills power was given to supply power outside for the use of railways and canals and things of that sort. When the Committee came to deal with the Bills of the companies, they would see that in this respect the London companies were seeking further powers to supply outside their present areas.

The Chairman: You are speaking for the companies, and not for the local authorities?

Mr. Balfour Browne said he was speaking only for the companies, but he would say that both the companies and the local authorities were practically confined to their areas. He felt that the attack made on the companies as to the way they had done their business was a silly attack, but still they had met it. They had ever regarded the future of their companies as dependent on the power load, and it was that which the Administrative Co. was going to take away from them. They had also given evidence that, under similar conditions, and with an equally good load, the present companies could do everything the promoters could do. In their own districts they were in a much better position to supply power than the Administrative Co. By far the largest amount of the expense of the London companies had been in relation to distribution. Both in local authorities' districts and the companies' areas their generating stations were in the midst of the district, and therefore they considered they were in a more favourable position to supply power at a cheap rate. He would ask the Committee to remember first that competition should be fair, and he thought it had been shown that the competition of the promoters with the present companies as they were regulated at the present time would be unfair. His learned friend seemed to be under the impression that the company would be bound to supply everybody in this huge area at the maximum price of 1½d. per unit. That was not the case, and he ventured to say that it never was the intention of the promoters. He said further that it was impossible for it to be done. He would give an example. Suppose he were a consumer in the West End of London and he asked them to supply him with electricity at 1½d. per unit when it would cost probably £30,000 to lay the main, would they do it? Of course they would want a guarantee. If he was a consumer wanting power for his works and was next door to their generating station, he could no doubt demand it at 1½d., but to tell him that the company would supply him if he went five miles off at the same price was a thing he could not believe. That was why the promoters said: "If you want a supply you must enter into an agreement, and if we cannot agree it must be settled by arbitration." That, of course, was a business arrangement, and he did not, and could not, complain of it on the ground of pure business, but was that putting themselves in the same position as the present companies?

The Chairman: They say they are prepared to do so.

Mr. Browne said they could not do it, and if the Committee laid clauses on the promoters to do so, he would guarantee to say they could not do it. He did not say that the guarantee clause from the promoters' point of view was unreasonable, but it was evident from what his Lordship had just said—

The Chairman: I am merely repeating their words. Do not take it that anything I say expresses an opinion. If you do you will go wrong.

Mr. Browne said the words might be taken to mean that the promoters could put themselves under those conditions, but he challenged his learned friend to say that they did. If the promoters were granted a fresh area compulsorily the Bill would go no further. On the other hand, if the promoters did not have a compulsory area, and only supplied on terms of arbitration under Secs. 52 and 56, then they would be competing with the other companies under unfair conditions. The present companies were bound to supply to everybody in the compulsory area, and to extend their mains on the request of two consumers upon a 20 per cent. guarantee for two years. But the promoters were bound to do nothing of the sort. They demanded, first, to have a guarantee of 20 per cent. for seven years; and, secondly, not only 20 per cent. on the cost of the mains, but also on the cost of any new works they had to put up at the generating station. He was not saying that was not reasonable, but it was not what they were leading the Committee to believe, that they were going to supply exactly as the present companies were. Then, again, he would ask the Committee to remember that every one of the companies fell into the hands of the local authorities in 26 years, and yet the promoters were seeking powers in perpetuity. His companies were bound to lay by a sinking fund to replace their capital, but the promoters would have nothing to lay by. But these were disabilities which had been placed upon the present companies by Parliament. Companies could not combine either with one another or with local authorities, but what were the promoters? They were a huge combine to begin with, and that was an absolute departure from the principle that local wants should be locally dealt with, and that there should be no trust formed to the detriment of the consumers. Mr. Ferranti said he would have a monopoly, but added that it would be a monopoly of cheapness. That was always the sentiment in the mouths of monopolists, but it ended in a monopoly of dearness. In examining one of the witnesses, he used the expression that the Bill was a breach of the bargain, and the Chairman asked him what he meant. He said distinctly that if Parliament passed this Bill it would be a breach of the Parliamentary bargain under which London companies held their position that day—a bargain carefully considered, solemnly entered into and ratified by Parliament. The first Electric Lighting Act was in 1882, and it was enacted that a company should have a concession of 21 years, and that at the end of that time the undertaking should pass into the hands of the local authority. It was soon discovered that capital could not be raised under such conditions, and accordingly, in 1888, Parliament reconsidered the whole matter, and the Bill which was presented to Parliament provided that the company should, at the end of 42 years, receive compensation not only for the plant, but for goodwill. When the matter was before Parliament, however, in order to get the Bill passed the companies withdrew the words as to goodwill, and left the words as they were in the Act. Mr. Browne proceeded to quote from a number of speeches made by Lord Thurlow, Lord Herschell and others on the matter when it was before Parliament, and said the obvious intention was to give the companies a monopoly for 42 years in order to get the public to subscribe the money. Now the Committee were asked to take away that security. He contended that cheapness was not everything, and that good faith was something, and asked the Committee not to depart from the principle of legislation under which people were induced to subscribe their money to provide London with electric light. Proceeding to deal with the inquiry by Major Marindin on behalf of the Board of Trade, on which London was portioned out to the different companies, he submitted that the principle laid down was that of no competition, and in a number of cases the Board of Trade would not allow the local authority to come in unless they purchased the undertaking of the existing company.

The Chairman pointed out that a good many of the companies were competing in the same districts, and some members of the Committee could not quite see where the monopoly existed.

Mr. Browne said that it was owing to the adoption of a new system. The old companies used the alternating current system, and new companies asked to come in with the continuous system. He admitted that competition did exist, but it was allowed as the competition of different systems. The Charing Cross Co. was allowed to go into the City to supply a different system.

The Chairman: You say these companies came in to furnish current of a different sort?

Mr. Browne: So far as I know in every case.

The Chairman: They were only admitted on that principle?

Mr. Browne: Yes, but they have changed their current now.

The Chairman: Is it due to that fact only that competition now takes place in these different districts?

Mr. Browne: So far as I know, to that fact only.

The Chairman: Is it not rather surprising that if the second company was only admitted because it supplied a different sort of current, that when it changed the original company should not have objected?

Mr. Browne: You cannot object after an Act of Parliament is passed.

The Chairman: But it did not stipulate what current should be supplied?

Mr. Browne: It did. The new company came in, and the old company changed to meet the new state of things.

The Chairman: There are some districts in which three companies are supplying?

Mr. Browne said there were very few districts in which three companies were supplying, and he did not know how they came in. With regard to this particular Bill, he would point out that London was unique in many respects, and the Power Bills which had been quoted had nothing to do with the matter at all. In the case of a number of Power Bills there were no proposals to include the districts of great local authorities. In the Lancashire Bill Manchester was left out, and in the Clyde Bill Glasgow was left out. It was true that in the Somersetshire Bill Bristol was included, but there was no case where a power company had, against the will of a company, got competitive powers. It was true that power companies had been let in where there were corporations, but corporations were only for lighting, and had no right to supply manufacturers.

The Chairman: Then you see no objection to Mr. Fitzgerald going into the districts of local authorities?

Mr. Browne: They must look after themselves. I do say there is a great distinction, for they are there in perpetuity, and they come in as lighting authorities.

Lord Robert Cecil, K.C.: I do not admit that.

The Chairman: You must be smarting under this.

Mr. Browne said the case of the promoters was built up on hypothesis, and he submitted that no case had been made out of public interest or public necessity, and he asked the Committee not to allow the Bill to proceed.

Mr. Fitzgerald, K.C., in reply, said the proposal before the Committee was the only proper way of dealing with the supply of electricity to the county of London and adjoining districts, and it was only in some way like this that they could ensure to the consumers of electricity in London that cheap supply of power which was necessary to enable the manufacturing interests to be put on a par with their rivals whether in this country or abroad. It was only in some way like this that they could ensure that the London consumer generally was supplied with cheap electricity that he ought to get, and by which they could remove London from the reproach of having dearer electricity, notwithstanding its size, than any other large town in the United Kingdom. Criticism against the framework of the Bill had been directed mainly by Mr. Neville and Mr. Balfour Browne. Mr. Neville had said that the Bill was wholly unreasonable, and that its provisions were wholly illusory, but Mr. Browne had admitted that from the promoter's point of view the provisions were reasonable enough. In fact, Mr. Browne was in charge of the next Bill on the list (East London and Lower Thames Bill) which had exactly similar provisions. Mr. Neville approached the Bill as if the provisions were entirely novel, and with an entire disregard of what the Parliamentary history of the question was, and he seemed oblivious of the fact that the provisions contained in the Bill were not devised by the promoters, particularly with regard to the provisions dealing with price. Mr. Neville had criticised and characterised them as a mere sham. But this was not the case. The provisions were framed not by the promoters but with the greatest care by a Parliamentary Committee appointed for the purpose and with the assistance of the Board of Trade. These provisions which had been so commented upon were settled by Sir James Kitson's Committee, and were approved by the House of Lords, and had since been followed in every case in which a Power Bill was passed. Now Clause 48 of the Bill dealt with the supply of energy within the districts of authorised undertakers, and it said: "Energy shall not be supplied under this Act by the company except to authorised undertakers or to the proprietors or trustees of any railway, tramway or waterworks, or of any dock, canal or navigation or any Government department, or to any persons whose installation exceeds 500 H.P. in any area being at the passing of this Act the area of supply of any authorised distributors except with the consent of those distributors, but that consent shall not be unreasonably withheld. If any question arises whether that consent is unreasonably withheld, that question shall be determined by the Board of Trade. The consent shall be deemed to be unreasonably withheld if the authorised distributors are not willing and in a position to give the requisite supply upon reasonable terms and within a reasonable time, and in considering what are reasonable terms and what is a reasonable time, the Board of Trade shall, amongst other things, have regard to the terms upon which, and the time within which, the company are willing and in a position to give the supply." It was said that that clause was no protection to the authorised undertaker, and it was argued that if the promoters offered to come into a district and supply at ¼d. per unit, then the Board of Trade would have to let them into the district of either a company or a local authority if the existing company or local authority was unable to supply at that rate. But under the clause it would be quite competent for the Board of Trade to say the offer of the power company was not a *bonâ fide* one, and refuse their consent. Criticisms of the kind had been made in other cases. They were made in the Somersetshire Bill with reference to Bristol, and the Committee who heard the Bill were so impressed with the argument that they intimated, in giving their decision and passing the preamble of the Bill, that some addition should be made to the clause for the purpose of preventing anything of that kind being done. The following morning a representative of the Board of Trade attended the Committee and produced a new sub-clause as follows: "In dispensing with any consent under this section, the Board of Trade may impose upon the company such terms and conditions as they may think necessary for the protection of the authorised distributors and such terms and conditions may at any time be enforced by the authorised distributors in any court of common jurisdiction."

The Chairman: Did those words find their way into the Act?

Mr. Fitzgerald: The Committee rejected them, but if you have any doubt, I have not the slightest objection to accepting the words.

The Chairman: Would you accept the clause if it read like this: The consent shall be deemed unreasonably withheld if the authorised distributors are not willing and in a position to give the requisite supply upon reasonable terms and within a reasonable time.

Mr. Fitzgerald: I would like to consider that.

The Chairman: If ever we reach this clause, we can argue about that.

Mr. Fitzgerald said he then came to clause 50, which dealt with supply to authorised undertakers, and his learned friends had dealt with this clause as if it applied to the supply to ordinary users. It was the third paragraph of the clause which was brought into question, viz., "Every authorised undertaker requiring a supply of energy shall enter into a written contract with the company (if required by them to do so) to continue to receive and pay for a supply of energy for a period of at least seven years of such an amount that the payment to be made for the same shall not be less than £20 per cent. per annum on the outlay (excluding expenditure on generating plant and any electric line then in use) incurred by the company in making provision for such supply." What that meant was this: If an authorised undertaker asked to be supplied he must guarantee that he would take a supply for seven years which would be equivalent at the maximum price to 20 per cent. on the outlay. It was not 20 per cent. on the capital outlay, but 20 per cent. on the necessary expenditure in giving him a supply. If the ring main was passing through the district of an authorised distributor this expenditure would be what was sufficient to connect the ring main with the station where the authorised undertaker would take his supply, and that expenditure might be £100 or £500, according to the distance, and 20 per cent. on that would be a nominal sum. A case might, of course, arise on the fringe of the district where it might be necessary to spend £5,000 or £10,000 on giving the supply, and in such a case it was perfectly reasonable that a contract should be made. The 20 per cent. on £10,000 would be £2,000, and supposing the price of the energy was 1d. per unit, it meant 480,000 units per annum. It would certainly be unreasonable for any company to be forced to lay down mains for the supply of a particular consumer, and more particularly for the supply of a large consumer, without any security that the consumer would take any supply at all. He understood that one of the conditions offered by the Metropolitan Electric Supply Co. to the Marylebone Borough Council was to take a supply for 26 years. Then clause 52 read, "The company shall give a supply of energy to any person other than an authorised undertaker, upon that person entering into a binding contract to continue to receive and pay for a supply of energy upon such terms and conditions as, failing agreement, shall be fixed by a single arbitrator appointed by the Board of Trade, and in fixing such terms and conditions, including a minimum annual sum to be paid to the company, the arbitrator shall have regard to the following amongst other considerations." That was an absolute obligation, for the matters which the arbitrator was to have regard to were the period for which the customer was prepared to bind himself; the amount of energy required and the hours during which the company could be called upon to supply; the capital expenditure in connection with the supply; and how far capital expended in connection with such supply might become unproductive to the company upon the discontinuance of such supply.

The Chairman: The impression on my mind is that there is an obligation to supply but upon terms, and of course these terms may be such terms that the man cannot take a supply. That does not say there is no obligation to supply, but simply that he is not tempted by the terms.

Mr. Fitzgerald said it was an absolute obligation to supply on such terms as in the case of a dispute shall be fixed by the arbitrator.

Mr. Balfour Browne: We do not say there is no obligation, but that there is no obligation to supply at 1½d.

Mr. Fitzgerald said that with regard to the terms set forth in provisional orders, the promoters did not attach any importance to what was contained in the ordinary form of a provisional order, and what was contained in Clause 52 of the Bill, and they were quite willing to come under the same terms.

On Monday, Lord Camperdown's Committee continued their hearing of the case.

Mr. Fitzgerald, K.C., continuing his address, said that Clauses 50 and 52 were clauses settled by Sir J. Kitson's Committee and had been inserted since that time in most of the Power Bills, which authorised the supply of electricity in bulk and detail. The next clause was Clause 53, which was commonly known as the stand-by clause. Mr. Neville commented on this clause at considerable length, and he said he had some difficulty in discovering the true inwardness of it, and he came to the conclusion that the object of the clause was to enable the promoters to charge twice over. The clause was the verbatim clause introduced in the Government Bill of last year for the revision of the Electric Lighting Acts, and this would be applicable to all electrical undertakers. That Bill was sent to a Select Committee of the House of Lords. Before that Committee every company and local authority was represented and agreed to the clause.

The Chairman said that Mr. Neville's point appeared to be this. If he looked at the second schedule, the charge to be made to any consumer should not exceed 1½d. per unit. Apparently, Mr. Neville maintained that "any consumer" ought to be made quite distinct and different to a person with a separate supply.

Mr. Fitzgerald said that the meaning of the clause was this. A man had a separate supply and wanted more. A minimum price was fixed and the man could take that out in electricity if he liked. If the man did not do this he would have to pay for the stand-by which relieved him of the necessity of putting up further plant. It was a grievance felt by all electrical suppliers that they had to supply a person who had already a supply of his own, and he might use very little.

Mr. Ram, K.C., said, with regard to Clause 50, in the case of almost every Bill the words "At a price not exceeding the prices stated in the second schedule annexed to this Act" appeared. He read from the Lancashire Bill, and there were many other Bills which contained the words. It was Sir Jas. Kitson's form, but the words were absent from this Bill. Mr. Neville's contention was that the omission of the words was vital.

Mr. Fitzgerald said he did not see that the omission of these words made the least difference. They were not found in the clause dealing with the supply to an ordinary consumer. He had Sec. 40 of the South Wales Electrical Power Bill dealing with supply to an ordinary consumer, and it did not contain these words.

The Chairman: Have you any objection to putting them in?

Mr. Fitzgerald: Not in the least.

The Chairman: Then if we reach that clause, we will put them in.

Mr. Fitzgerald said that Sec. 56 was an important one, as it dealt with maximum prices. What he said about these maximum prices was that they were prices intended to be operative, and which the consumer was entitled to have the benefit of. The maximum price must of necessity be fixed to meet the most unfavourable case against the company, and accordingly in the first portion of the schedule they had taken 1½d. per unit to meet the most unfavourable case. That was the case of a man merely taking a supply of one or two hours a day, and that man would be enabled to take a supply at 1½d. a unit. From the evidence they had before them, he did not think that they would find any company supplying at that rate. But it went further, because the next section gave a power user the opportunity, if he liked, of availing himself of this section. It said: "The consumer shall, if required by the company, make such charge by way of a fixed sum per quarter not exceeding £1 per quarter per kilowatt of the maximum power required to be supplied, and in addition a sum not exceeding ¾d. per unit for all units supplied to such consumer." If the user was taking a supply for three hours a day, that would be the cheapest way for him to take it, and he would show then how it would work out. They had in their mind, no doubt, that the Board of Trade unit was a kilowatt hour. A consumer of one kilowatt for eight hours a day would use eight units per day, or, excluding Sunday, 48 units per week, or 624 units per quarter. Under Sections 1 and 2, of the schedule, 624 units would work out at a total charge of £2 6s., or under $\frac{9}{10}$ths of a penny. If instead of eight hours he was using the supply for 16 hours, the price per unit would be very much decreased. If they looked at Clause 57 of the Bill which was the sliding scale, they would see it said: "If in any year the average price per unit obtained by the company for energy supplied by them, throughout the area of supply, is less than 1½d. per unit, the dividend which the company is authorised to pay in that year may be increased in the ratio of ¼ per cent.," and so on. The effect of that clause was this: If they charged an all-round price of 1½d. per unit, their dividend would fall to 4 per cent., and if they charged an all-round average price of 1½d., which was their maximum, they could receive no dividend at all, and therefore they had in the provisions of the Bill the most absolute security, for equitable charges would be made, because unless they got a charge which was, at the least, 1d. all round, they could not get their standard dividend. In addition there was a provision in Clause 61 as to a revision of prices. The only other clause to refer to was Clause 69, which, from the comments made, would appear to have been inserted with some Machiavellian design to do away with the companies in London. It was a clause which was found in some shape or form in five or six of the Power Bills, and in the identical shape in two or three Bills, and the object was this: There were in London a certain number of local authorities who were carrying on their undertakings at a loss, and there were one or two small companies in the outlying parts of the district who were also working at a loss, or nearly at a loss. It was possible in such cases that the undertakers would be willing to transfer their undertaking to the Power Co. by agreement, and this clause would allow them to take over the Orders and carry the undertakings on. But it could only be done by agreement and with the consent of the Board of Trade, and therefore he should have thought it was a perfectly harmless clause. It was not, however, a clause to which the promoters of the Bill attached very great importance, and if the Committee thought there was any hidden danger in it, they could strike it out of the Bill. Now it had been suggested that because the power of purchase by some local authority—he did not know whether by the London County Council or a combination of Borough Councils—was not inserted in the Bill, it was unfair to existing companies and local authorities, but really there must be some finality in such matters. When the matter of supply in bulk was first raised, it was referred to a Joint Committee presided over by Lord Cross, and that Committee reported against the purchase of power companies by local authorities.

The Chairman: I may say with regard to this particular point of making large power companies purchaseable by a local authority, the Committee have no intention of departing from the recommendations of Lord Cross's Committee, so that you need not argue that point.

Mr. Fitzgerald said it was quite true that the existing companies' undertakings were purchaseable at the end of 42 years, and that unless they kept their generating stations going they would get nothing from the purchasing local authorities. It would be a matter for the individual companies to consider what was most advantageous to them—either to keep up their stations or to take a supply from the Power Co. and get increased dividends now. The directors of those companies would, of course, act on commercial principles, and if they found that they could get their electricity cheaper by taking it from the company, of course they would do so. This Bill would not alter their position in one iota. But the local authorities in dealing with this matter, through Mr. Blennerhasset, pursued a different argument.

The Chairman pointed out that the argument of the companies was a much stronger and larger one, than that of the mere scrapping of their stations. The main contention of Mr. Balfour Browne was that it would be a great hardship to them that, having been given 42 years only by Parliament, they would be competed with by another company, which would come in under entirely different conditions.

Mr. Fitzgerald said he was going to deal with the whole point of competition. What he was saying now was that the scrapping of stations was a matter entirely in the hands of the directors to do what they thought best, and they would not do it if it was not profitable. Of course, in the event of purchase of the existing company by the local authority, the power company which might be supplying the existing company would not be so foolish as to refuse to supply the purchasing local authority at the same rate. Then it was said that the Bill was contrary to precedent and contrary to all previous legislation on this subject, and it was suggested that in every previous case, with the exception of Bristol, the local authority or company objecting to a Power Bill had been cut out of the Act. What created a Parliamentary precedent was where the opposing parties came before a Committee, and, after hearing both sides, the Committee gave a decision. Where the parties had agreed outside and came before a Committee and presented a Bill agreed upon, no Parliamentary precedent could be said to have been created. Where the matter had been fought out, it would be found that the weight of precedent was in favour of inclusion. In the South Wales Bill, Swansea, Cardiff and Newport were included by the House of Commons Committee, but before the Bill got to the House of Lords, the parties agreed to leave these towns out. In the Cleveland and Durham Bill, Committees of both Houses included Darlington, Stockton, Middlesbrough and East Hartlepool. In the Somersetshire Bill, Bristol and Bath were included. Against these three cases the only case in which the matter was fought out was the Clyde Bill, and Partick was struck out. Mr. Balfour Browne contended that in 1888, a Parliamentary bargain was made by which the companies should get orders for 42 years without competition, and that it would be a breach of this bargain if this Bill was passed. But the very first section of the Electric Lighting Act of 1888 undoubtedly contemplated competition.

Mr. Browne: I said that Clause 1 only allowed persons to come in on the same terms.

Mr. Fitzgerald said it would be an extraordinary thing to infer a Parliamentary bargain from an Act, which stated distinctly that there should be no monopoly. As a matter of fact, there was competition in a great many districts of London. Sir Francis Marindin's report had been quoted, but all he said was that it was not advisable to grant more than two orders in a district, and that it would be better to allow one alternating and one continuous supply as one of the systems was better for motors. If Mr. Browne was right in his argument that competition was only to be allowed where there was a different system, then he would say that the system his company would supply on was the three-phase, and there was no company or local authority at present supplying in that way. If his friend's view was correct that was the end of the matter.

Mr. Browne: The County of London has a two-phase supply convertible to the three-phase by a transformer.

Mr. Freeman: St. Pancras has the three-phase.

Mr. Fitzgerald said he thought the Committee would see how absurd was the contention, that allowing the alternating and continuous systems was not competition. To deal with the whole question of competition between this company and the existing company, he would point out that with regard to the bulk of the companies the promoters would not compete at all, and with regard to the four companies in the industrial area, it was a competition for 8 per cent. of their existing business. Certainly that did not justify the use of the expression that this was an attempt to crush these companies out of existence. It was nothing of the sort. There would be competition, but it would be for business which the companies had not so far acquired, and which so long as they carried on their undertakings on the present lines, they never could acquire. Mr. Lewis Coward had addressed the Committee on behalf of the London County Council, and the suggestion running through his speech was that the County Council, but for the intervention of the Government, would have brought in a Bill making them the purchasing authority, and that apparently the Government was considering the advisability of bringing in a Bill with the same object. But there was not a tittle of evidence to support such a statement, and what Mr. Coward was referring to was undoubtedly the Bill which the Government brought in and carried, to deal with the overlapping of areas caused by the creation of the Borough Councils. The case for his Bill was that owing to the density of population, London could be supplied with electricity cheaper than any other district, but this could only be done by taking advantage of the economic system of concentration in the generation of electricity, for magnitude was the important factor in the economy of producing electricity. In this case he thought the interests of the public had been somewhat lost sight of. The Committee had been hearing of the grievances, and apprehended losses of companies and local authorities, but he took it that the evidence conclusively showed that if the manufacturers of London were to get a cheap supply of electricity, they must get it in some other way, than they were able to get it at the present time. They found that with the exception of two local authorities, the average rate of supply was 2d. per unit, and it was absolutely impossible to get a manufacturer of any size to take energy at that rate.

The Chairman: The opponents say although they are supplying at 2d. now, they have reduced their prices, and see their way to reduce it to 1d. They have also pointed out that they have facilities for increasing their generating stations and extending their works generally.

Mr. Fitzgerald said the County of London Electric Supply Co., who had pushed power supply more than any other company, showed that their average price was 2d. The question for the Committee to decide, was whether, if London was to have a cheap supply of electricity, it was more likely to get it from the promoters or from the existing companies. In the case of the local authorities, they found that actual losses were shown by West

Ham, Fulham, and Battersea, and in other cases where there was a profit, it was arrived at by charging themselves an excessive price for electric lighting. In the case of Southwark, the local authority was supplying itself with electric light at 2½d. per unit, and refused to take it from a company at 1½d. per unit. If business was carried on in that way, of course they could show a profit. As to the companies, six of the most important in the West End would not be touched by the promoters at all, except that they might prefer to take a supply from his company. So far as the manufacturers were concerned, what could be done on the Tyne could be done on the Thames; and there were a number of their large railway companies who would be compelled before long to electrify their suburban lines, and who would doubtless be glad to take a supply of current. With regard to the statement that the Bill would create a huge trust, he denied that it would do anything of the kind, and it was open to the Committee to pass another Bill or all the Bills if they pleased. He did not ask the Committee to do that, but if they did he would not be afraid. The promoters were men of financial stability, and in the interests of London he asked that the Bill should be allowed to proceed.

This concluded the hearing of the Bill, and the Committee reserved their decision.

It has been decided that the Committee shall not sit again until May 9th, when the case of the East London and Lower Thames Electric Power Co. will be opened.

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### Rhondda Tramways.

On the 6th, 7th and 10th inst. Sir L. M'Iver's Select Committee of the House of Commons was engaged in the consideration of the Rhondda Urban District Council Bill, which, in Clauses 8, 9 and 10, asked that the powers granted in the Act of 1902 for the compulsory purchase of land for tramway purposes, widening of streets, &c., should be extended for three years; that the period limited for the construction of tramways should be extended for three years; and that, notwithstanding anything contained in Sec. 30 of the Act of 1902, if the Council entered into an agreement with any company for the construction and equipment of the tramways authorised or leased such tramways, such lease might contain a clause authorising the compensation to be made by the Council to such company on the expiration of the lease, to be on the terms of paying the cost of construction of the tramway lines, less proper deduction for depreciation, &c.

Mr. Balfour Browne, K.C., who represented the promoters, said: At present the only means of communication at Rhondda was the Taff Vale Railway. The want of further facilities was greatly felt, and as long ago as 1882 tramways were sanctioned. Only three miles were constructed—from Porth to Pontypridd—and half of this was in the Rhondda district and half in Pontypridd. The line came into possession of the British Electric Traction Co., who promoted an extension to Penrhy-craig, which was passed by the Light Railway Commissioners but was afterwards rejected by the Board of Trade. In 1902 the District Council came before Parliament and got powers to make considerable extensions of the tramways. The Taff Vale Railway Co., opposed the Bill, and a clause was inserted in the Bill as follows:—"The Council shall not commence the construction or laying down of the tramways or any part thereof unless and until they have entered into an agreement with a company or person to be approved by the Board of Trade for the lease to such company or person of such tramways or parts thereof as the case may be, for such period (not exceeding 42 years) at such rent and upon such terms and conditions as may be approved by the Board of Trade; provided that in any such lease the amount to be paid to the Council by way of rent shall in no case be less than a sum sufficient to pay the interest on any moneys required to be borrowed for the purpose of the construction of the tramways and for the generating station and the electrical equipment of the tramways or any part or parts thereof so leased aforesaid, and also sufficient to provide the requisite appropriations, instalments or sinking fund payments." Of course, that meant that before they could construct the tramways at all they must secure someone who was willing to give a sufficient rent to make it impossible for loss to fall upon the ratepayers, and while that was satisfactory to the Railway Co., it put a great difficulty in the way of the District Council, because, in the first place, the key of the whole situation was the little horse tramway from Porth to Halfod, and until they obtained possession of this and so joined up with the Pontypridd tramways, it was no good working the system. Sec. 30 of the Act of 1902 said that the powers of the Council to construct and equip the tramways should not be exercisable by the Council, but might be exercised by their lessees; and as consideration for the construction, the Council might lease the tramways for any period not exceeding 42 years on terms and conditions to be approved by the Board of Trade, and that such lease might contain a clause requiring compensation to be made to the lessee on the termination of the lease similar to those contained in Sec. 43 of the Tramways Act of 1870. It was under that clause that the Urban District Council was now proceeding. The British Electric Traction Co. asked a large sum of money for the tramway they possessed, but the U.D.C. had now purchased that, and the whole of the matter was completed in June last. Then they had to try and get somebody to take a lease and pay them a sufficient rent to enable them to pay back the necessary instalments and sinking fund, and there was considerable difficulty about that. Ultimately they succeeded, and a contract had been signed which awaited the approval of the Board of Trade. It was in consequence of this delay that they were asking for a further extension of three years.

Sir Douglas Fox was called, and thought the extension of time asked for was reasonable. He had a good deal to do with the negotiations, and found it impossible to arrange with substantial persons to carry out the project until the horse tramways had been purchased and the Pontypridd connections made.

The Committee found the preamble of the Bill proved, but limited the extended period for the purchase of land to one year. They declined to extend the time for the completion of the tramways, as they considered that the time now at the disposal of the promoters was sufficient for the purpose.

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*The Supply of Electricity Bill.*—The *Times* says that the object of the Supply of Electricity Bill, introduced by Mr. Bonar Law in the House of Commons on 6th inst. (on behalf of the Board of Trade), is to amend the Electric Lighting Acts in order to bring them more up to date, the principal proposal being one enabling the promoters to proceed by provisional order rather than by Bill and so save expense. The measure is submitted in the form in which it was passed by the House of Lords last session, after having been referred to a Select Committee before whom all parties interested were given an opportunity of expressing their views by counsel. In deference to the arguments put before them the Committee made numerous alterations in the Bill. In the stages subsequent to its consideration by the Select Committee the measure was amended on one point only. This amendment was moved by the Chairman of the Select Committee with the consent of all his colleagues. The Bill deals with such matters as the compulsory acquisition of land for generating stations, the breaking up of streets outside the area of supply, the supply of electricity in bulk, the exercise of electric lighting powers by authorities jointly, the consents of local authorities, revision of maximum price, and certification of meters; and also contains provisions concerning the association of undertakers and the protection of gas undertakers.

*Third Reading.*—In the House of Commons on 6th inst. the Chelsea Electricity Supply Bill and the Weybridge and Walton-upon-Thames Electric Supply Bill were read a third time.

*Southend and Colchester Light Railways.*—A Select Committee of the House of Lords has considered the above Bill, which seeks to authorise the Southend and Colchester Light Railway Co. to construct piers and work ferries across the River Crouch and the River Blackwater; to acquire Creeksea Ferry; raise additional capital, &c. Mr. Henlé, who appeared for the promoters, said that the Board of Trade had already authorised 27 miles of light railways, starting from Rochford and going *vid* Burnham-on-Crouch and Southminster to Bradwell-on-Sea, and thence on to Colchester. The route, however, was broken by the Rivers Crouch and Blackwater, and the idea was to have these ferries and so make a continuous route. The company had powers to work the line by electricity. The line would be a great convenience to the public. After calling evidence, the Committee found the preamble of the Bill proved.

*Mexborough and Swinton Tramways.*—This Bill was last week before Lord Balfour of Burleigh's Unopposed Bill Committee of the House of Lords, and was ordered to be reported for third reading.

*Electro-Peat Coal Manufacture.*—In the Parliamentary papers, Mr. Long, answering a question by Mr. Field as to whether the Irish Board of Agriculture had appointed an expert to inquire and report upon the electro-peat coal manufacture, said the Department had inquired into certain processes for the manufacture of peat fuel by electricity, but in the absence of information as to the particular process referred to in the question, they were not prepared to express an opinion as to whether it could be successfully carried out in Ireland.

*Woolwich Corporation Bill.*—The Select Committee presided over by Mr. Bill, on going through the clauses, amended Clause 17, which gave the Council power to supply electricity in bulk by agreement to neighbouring authorities, or to obtain such supply from other authorities. By the amended clause, other authorities can only supply electricity for use in the detached portion of the borough on the north side of the River Thames.

*Aberdare Tramways Bill.*—On Thursday last week, after deliberating for a short time, the Committee rejected the tramway portion of the Bill.

*Birmingham Corporation Bill.*—This Bill has been considered by the Select Committee on Unopposed Bills, and ordered to be reported for third reading. The Committee fixed the periods for repayment of loans as follows:—£296,000 for the construction of tramways, 30 years; £555,000 for the reconstruction of existing tramways, electrical equipment, purchase of land for the construction of generating stations and transforming works and tramway depôts, 25 years; £203,000 for the purchase of land and construction of street works, 60 years. A report was received from the Board of Trade from which it appeared that the proposed fares on through cars would confer powers of charge in excess of those usually granted in respect of tramways. They pointed out, however, that similar powers were given to the Glasgow Corporation, and were also allowed by the House of Commons Committee in the case of Leeds, and the Board did not suggest any alteration. The time limited for the construction of certain of the tramways proposed to be authorised by the Bill was two years from the widening or improvement of the streets along which they were to be laid, and within a period of seven years from the passing of the Act, and the Committee thought this was a reasonable time.

*London United Tramways Bill.*—At the sitting of the Court of Referees last week, the London United Tramways Co. objected to the *locos* of the Wimbledon Urban District Council and the Malden and Coombe Urban District Council against the London United Tramways (Extension of Time) Bill. Mr. Hutchinson represented the Urban District Councils, and said that although the promoters had obtained powers in 1902 to purchase lands and construct tramways, nothing had been done. The District Councils felt that the development of the district was being affected by the delay, and objected to any further delay. Mr. Balfour Browne, K.C., on behalf

of the promoters, pointed out that the scheme involved a capital expenditure of £750,000, and the company were buying land for widening the streets as quickly as possible. The Court refused *locus* to the petitioners.

## LEGAL.

THE MAYOR, ALDERMEN AND BURGESSES OF THE BOROUGH OF SUDBURY *v.* THE EMPIRE ELECTRIC LIGHT AND POWER CO., LTD.

THIS case came before Mr. Justice Warrington in the Chancery Division on Thursday, April 6th.

Mr. Hewitt and Mr. Edward Farrow appeared for the plaintiffs, and Mr. Geo. Cave, K.C., and Mr. Rolt for the defendants.

Mr. HEWITT, in opening the case, said the action was by the Corporation of Sudbury, who claimed a declaration that an agreement of May 30th, 1904, between the Corporation and the defendant company had been validly determined by the plaintiffs by reason of the default of the defendants, and the plaintiffs claimed the payment of £2,000, the sum named in the agreement, and alternatively there was a claim for general damages. The facts were these: In 1900 the Corporation obtained a provisional order, "the Sudbury Electric Lighting Order, 1900." Sec. 3 stated that the order was to come into force and have effect from the day when the Act confirming the order was passed, and that the undertakers for the purposes of the order should be the mayor, aldermen and burgesses of the borough. The Act was passed confirming the order on June 25th, 1900. The plaintiffs were unable to obtain a loan from the Local Government Board to enable them to work the order themselves, and by June 25th, 1902, the time limited by the order for doing the works expired. On September 25th, 1902, the town clerk of the Corporation wrote to the Board of Trade saying that they were making arrangements for the carrying out of the provisional order. On October 18th, 1902, the town clerk wrote to the Board of Trade, saying that the Corporation were desirous of entering into an agreement with a company to carry out the electric lighting order granted to the Corporation. He said that the terms offered to the Council were considered to be very favourable in the interests of the borough, and they asked the Board of Trade to sanction their entering into such an agreement. In reply to that the Board of Trade wrote on October 23rd, 1902, that they had no authority to sanction such an arrangement. That letter of October 23rd, 1902, from the Board of Trade was understood by the Corporation, and properly understood, he (counsel) submitted, to mean that the Corporation could do it without the sanction. He said that by Sec. 11 of the Electric Lighting Act, 1882, it was provided that any local authority who had obtained a licence or order might contract with a company for the execution or maintenance of any works for the supply of electricity in the area mentioned or any part of such area, but no local authority should by any contract or assignment transfer to any other company or person, or divest themselves of, any legal powers given to them, without the consent of the Board of Trade. Prior to September, 1903, the draft of the present contract had been drawn up and submitted, and Mr. Slatter, the managing director of the defendant company, wrote to the town clerk, advising him to communicate with the Board of Trade stating that the Corporation were negotiating with the company. On September 17th the town clerk wrote to the Board of Trade that he was directed to inform him that negotiations were still in progress in the matter, and that the Corporation were then in negotiation with another party—the present defendants—and that the Corporation had every reason to believe that the matter would very shortly be completed satisfactorily. In those circumstances he was directed to express the hope that the Board of Trade would extend the time of the order. The Board of Trade agreed to an extension of six months. On March 1st Mr. Slatter wrote that owing to the large amount of work the company had in hand, and to the fact that the financial market was exceedingly bad at the moment, the matter had better be postponed for two or three months, and that this would make no difference to the Corporation, as they would not in any event be able to supply current that year. The town clerk forwarded a copy of this letter, which was regarded as a cancellation by the company of the agreement, to the Board of Trade, asking for a further extension, which was granted until December. They added that if the undertakers had not then taken definite steps to carry out their obligations under the order, the Board of Trade, as then advised, would not allow the order to remain longer in force. In May the agreement on which plaintiffs sued was entered into, and it was suggested now for the first time in the defence that the agreement was invalid, and therefore that they could not recover under it. The agreement was not a transfer or a divesting of any legal rights or liabilities, but it left the Corporation the undertakers with all the obligations of undertakers, as regarded third persons, which they had before the agreement was entered into. The agreement, however, provided for an indemnity to the extent of £2,000 in the event of default by the company. The defendants denied breach, and denied that the agreement was validly determined, and said alternatively that the £2,000 was a penalty only, and was not recoverable as liquidated damages. In December, after the action was commenced, the Corporation endeavoured to obtain a further extension of time, but were unsuccessful, and the order was revoked on January 30th.

Without calling on the other side, his LORDSHIP proceeded to give judgement. He said the Electric Lighting Act of 1882 provided that a corporation might contract with any person or company for the execution of works to enable them (the corporation) to carry out the undertaking of supplying electricity, and they might buy current from the outside person or company, but it prohibited the undertaker by any contract or assignment from transferring to another company or person, or divesting themselves of any legal powers given them or liabilities imposed upon them, without the consent of the Board of Trade. That meant that the power which the provisional order gave to the local authority of itself supplying the district was not without the consent of the Board of Trade to be put into the hands of any other person. The agreement, however, contained a clause to the effect that the company should "manufacture, distribute and supply electricity and carry out the provisional order as if the company were the undertakers, except as in this agreement otherwise provided." The company, also, were to fix the charges and to enforce regulations. It was clear that it was contemplated that the entire business was to be handed over to the company. The agreement, therefore, was one which was prohibited by the Act of 1882, and could not be sued upon. Judgement for the defendants with costs.

DUGALD CLERK *v.* THE MOTOR-CAR CO. (1905), LTD., AND MR. MOFFAT FORD.

IN the Chancery Division of the High Court of Justice on Friday, Mr. Justice Farwell had before him the case of Dugald Clerk *v.* The Motor-Car Co. (1905), Ltd., and Mr. Moffat Ford.

Mr. UPJOHN, K.C., who appeared with Mr. Waggett for the plaintiff, said Mr. Dugald Clerk was the well-known consulting engineer, who had given evidence frequently in the Courts on matters of engineering and electrical and chemical science. The action was for an injunction to restrain the defendants from circulating or publishing by means of a pamphlet entitled, "Let the Judges Decide," or otherwise any advertisement, statement, or representation that the plaintiff undertook, or had been engaged to act as judge of automobiles or motor-cars, on behalf of, or at the request of the defendants, or in any manner by advertising or otherwise injuring the plaintiff in his profession or business.

His LORDSHIP, in giving judgement, said he had no doubt in this case that the defendants must pay the costs of the action. There was nothing whatever to justify certain statements in the pamphlet. One of the most objectionable statements with regard to Mr. Dugald Clerk as a judge, was that which set forth that the specific requirements of each client would get a much fuller consideration from the judges than they could possibly receive if a client went to any of them privately. Another statement in the pamphlet, to his Lordship's mind, would expose Mr. Dugald Clerk to the possibility of an action by a dissatisfied purchaser he had advised. His Lordship also had some dislike to the statement as to the clients being advised "absolutely free of charge." His Lordship accordingly granted the injunction asked for, with costs.

PATENT EXPLOITATION, LTD., *v.* AMERICAN ELECTRICAL NOVELTY, &C., CO., LTD.

THE plaintiffs' appeal from a judgement of Mr. Justice Buckley has been occupying the Court of Appeal this week. Our report is held over until our next issue.

## NEW PARTY-LINE TELEPHONE SYSTEM.

WHILE the "unlimited service" system provides for the needs of the large trading firm, and the message-rate system for the more modest requirements of the professional man, there remains an enormous number of potential telephone subscribers whose wants have hitherto remained unsatisfied—namely, those, such as private residents, whose calls would not, as a rule, exceed one or two per diem at the most, and would often be but one or two a week. The party-line systems devised up to the present usually provide for only four subscribers in a group, and possess many drawbacks, such as lack of privacy, liability to be blocked by the carelessness of any one subscriber, excessive complication of mechanism, &c. In order to meet the demand for a party-line telephone at a moderate price, which should be free from the above-mentioned defects, Mr. Paul Arnheim has been working for several years on the development of a new system, which has now been perfected, and on Monday last we were present at a demonstration of its capabilities at the offices of the Berliner Telephone Manufacturing Co., in Upper Thames Street. Mr. I. B. Birnbaum, manager of the Company, was the demonstrator, and performed his duties with characteristic enthusiasm and lucidity.

The Arnheim system, we understand, is now undergoing trial at the hands of the National Telephone Co., with the interested approval of the Post Office Telephone Department. It provides for any number of subscribers in one group up to a maximum of 25, but, as shown, was arranged for 10 stations. The essential features which characterise the system are:—The impossibility of overhearing or of interruption; the use of selective ringing, whereby only the individual subscriber who is wanted is called; and the facility for supervising the line from the exchange, the operator being able to cut off any station where a block has occurred,

and to set free the line for the use of the subscribers; but, incidentally, there are many other novel features associated with the apparatus.

The apparatus involved consists of a telephone set externally similar to the ordinary type at each subscriber's station, an automatic selector switch, and the corresponding operator's position at the exchange; there is also an automatic electric pendulum at the exchange, which is common to all the party lines. The automatic selector switch is fixed in the house of one of the subscribers, or in any other convenient position in the vicinity of the group of subscribers; each station is provided with an earth wire, and with two wires leading to the selector switch, while from the latter one pair of wires runs to the exchange. The respective circuits are therefore absolutely independent up to the selector switch, and the latter is so arranged that only one subscriber's circuit at a time can possibly be connected with

Fig. 1.—Operator's Position.

the wires running to the Exchange; thus overhearing is absolutely impossible.

On the subscriber's apparatus is a push-button. To originate a call, he presses this button and lifts the hand combination from the cradle; the effect of this is to close a circuit in connection with the pendulum at the exchange, allowing impulses of current to pass through the selector switchgear, and causing a double-pole switch-arm to move over a series of contacts until it reaches those belonging to the calling subscriber, when the pendulum circuit is automatically interrupted, and the switch-arm becomes locked in position. The subscriber is then through to the exchange, and his push-button rises, indicating the fact. He calls the exchange with a magneto in the ordinary way, and rings off in the same way when his conversation is completed.

We may pause here to explain how interruption is prevented. Should a subscriber press his push-button when the line is engaged by another subscriber, the button remains depressed, and nothing happens; he cannot in any way affect the selector switch, or overhear or interrupt the person in possession of the line, his own circuit being entirely disconnected. But directly the line is cleared, his push button rises, indicating the fact as before, and he acquires possession of the line in his turn, the selector switch automatically putting him through. The same holds good for any number of successive calls.

Starting from the other end, when a call is to be made from the Exchange, the operator plugs into the party-line jack, and selects the individual subscriber required by means of an ingenious switch, calling for the minimum of manipulation. She merely inserts the tip of her finger into one of a series of numbered holes in a dial, and pulls it round against a stop; the dial rotates a switch through a corresponding angle. The operator then releases the dial, and presses her ringing key, which closes a circuit allowing the switch to slowly rotate back to zero; in so doing it makes a number of contacts corresponding to the number of the subscriber's station on the party-line. By this means a series of impulses is allowed to pass to the line from the motor-generator at the Exchange, actuating a relay in the selector switch and causing the mechanism to make a corresponding number of steps. The switch thus comes on to the contacts of the subscriber wanted, simultaneously ringing the subscriber's bell. The connection is maintained for a period of 50 seconds, during which the operator can ring repeatedly; but if the subscriber does not reply within that period, the apparatus automatically resets itself and clears the line. If, however, the subscriber answers, the switch is locked, until he rings off in the usual way.

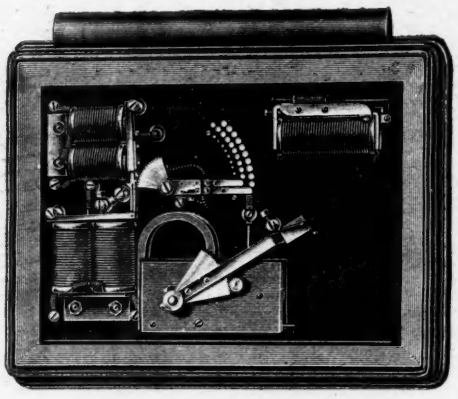

Fig. 2.—Automatic Selector Switch.

Fig. 3.—Electric Pendulum.

We should add that magneto ringing is not essential to the system, which is equally applicable to common battery working, and is, in fact, working on the latter system at one of the National Telephone Co.'s exchanges.

It is obvious that if a subscriber failed to replace his hand combination and ring off, the line would be blocked, as the selector switch would remain locked on his circuit. To guard against this, the operator at the exchange supervises the circuit at stated intervals of, say, 10 or 15 minutes. If the line is engaged, but no conversation in progress, she withdraws the plugs, when the selector switch immediately returns to zero. Any other subscriber can then call or be

called, but the guilty one, who has forgotten to ring off, remains isolated until he replaces his hand combination.

The accompanying illustrations show the external appearance of the principal items of apparatus.

We have mentioned the main features of the system only; there are many interesting and ingenious details to which we have not referred, as they would be unintelligible without the diagrams, for which we have not space at the moment. It will be seen, however, that all the chief requirements of an efficient telephone service are complied with by Mr. Arnheim's system, to an extent hitherto unattained. The cost will probably not exceed £2 per station. The only part of the mechanism where troubles might be anticipated is in the selector switch, and this is by no means so complicated or delicate as might be supposed. Having regard to the reliability which has been attained in the construction and use of relays, of which there are tens of thousands in a modern exchange—to say nothing of the marvels which have been accomplished in the way of automatic telephony—we see no reason to anticipate difficulties in this respect, and we hope that the advantages offered by the system will shortly be realised by thousands of new subscribers.

## CORRESPONDENCE.

*Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

### Lightning Conductor for Small Yacht.

Cruising in a part of Scandinavia in which thunderstorms are heavy, and boats not infrequently struck, I should be most grateful to you, or any of your readers, who would give advice in your columns as to the advisability of fitting a lightning conductor, and, if it would be a protection and not increase danger to the occupants of a small craft, what would be the best way to fit it, and the right size of conductor?

The boat is 26 ft. long, yawl rigged, wire rigging, lead keel about one ton; "Vosper" paraffin auxiliary motor aft. She is built of wood, decked, and with sleeping cabin under coach roof. The mainmast is about 20 ft. from the deck to the top.

My idea was that it might do to take a copper wire rope from the masthead to the bow, and connect it there to a metal band carried down in front of the cutwater and under the wood keel till it connected with the lead keel. I have failed so far to get any information on the subject.

**M. S.**

### A Correction.

The three degrees of comparison, of which "expert witness" is the third, are too well-known to need quotation at length. Some think there is a fourth, viz., "company promoter." For fear I should be taken as representing a fifth and even deeper depth, may I ask you to correct the report, in your issue of the 7th inst., of my evidence before the Lords Committee on the Electrical Bills. I did not say that I had put down a 400-KW. station for £8 a kilowatt but for £50 a kilowatt, as may be seen by reference to the official shorthand notes. When anyone erects a generating station of *any* size for £8 per kilowatt, may I be there to see!

**C. H. Wordingham.**

London, *April 8th*, 1905.

### Labour-Saving Machinery in Central Stations.

Your contributor makes several slips in the practical consideration of this question, and of such a nature that his argument comes to very little.

Taking his example of mechanical stokers, he shows a saving in labour of £4 10s. This is the payment for 180 hours' work—not a very high rate of wage, but let that pass. Suppose that we do without the mechanical stokers, is it possible to engage a man for the 180 hours? With the 180 hours spread out with the fine graduation of daylight hours, how many days will it be necessary to engage the extra man?

On paper, of course, you fill in his spare time with odd jobs; in practice, you get your odd jobs done all the same by the rest of the staff. The £4 10s. estimate is just a trifle too theoretical.

Again, take the power-driven overhead traveller.

Surely the traveller itself is a labour-saving appliance, and its load factor does not justify its existence. Time saving, however, is a great consideration in a power station, and if you go so far as to provide a traveller to save time it is a question whether the increased speed attained by a motor is not worth while too.

Take the writer's case at its worst, say, 9 boilers with stokers at £80, and say £200 for traveller extravagance, and we have £920 too much capital divided by 3,700 KW., and we get 5s. too much per KW.! This does not help us very much to explain the high rate of £72 per KW.

Every little helps, no doubt, but there does not appear to be very much of a case against labour-saving appliances.

**Reader.**

The author of this article has, I think, been somewhat sparing in his estimate of the cost of labour saved by using mechanical stokers.

To illustrate what I mean I will utilise his figures. He estimates that four boilers will work only 180 hours, which, at an average of two hours per day, gives us 90 days. He assumes that one man will be saved by using mechanical stokers at 6d. per hour (£4 10s. ÷ 180), a rate which is rather below a stoker's wages. He quite forgets that you cannot get a man to come for two hours per day, and that he would have to be taken on for a whole shift of eight hours, which gives us £18. This I consider to be too low an estimate, and that you would have to employ the extra hand for about two-thirds of the year, say, 200 days at 4s., £40, which gives a saving of £10 per annum in favour of the mechanical stoker. Also, as the author admits, mechanical firing is more efficient, and there is, consequently, a further saving in the amount of coal used, besides being able to use an inferior and cheaper grade.

With the other parts of the paper, where it is pointed out that coal-conveying plant and electrically-driven cranes are false economy except in large stations, I am in full agreement with the author.

**Henry S. Watson.**

Westminster, *April 11th*, 1905.

### Tests on Stirling Boilers at Neepsend Works.

I have had my attention drawn to a paragraph under the heading of "Calorific Capacity of Fuel," on p. 534 of your issue of March 31st, which contains a statement by a correspondent that the calorific value of Shireoaks coal as used in the above tests being only 11,886·7 B.Th.U. hardly seems rational.

I beg to inform your correspondent, whoever he is, that I have taken tests of the same Shireoaks coal during the last five years, and on going through these tests I have taken the mean of a large number, and they work out to 11,897·25 B.Th.U.

This figure is not very different to that published in the boiler tests referred to, and I think it shows that your correspondent should not make such rash statements unless he is able to support them.

**S. E. Fedden,** *Manager.*

Sheffield, *April 11th*, 1905.

### Localisation of Faults on Cables.

I have noted Mr. F. C. N. Bergh's letter in your issue of the 7th inst., and should like to make a few comments on it before the correspondence on this subject is closed.

I am not in a position, of course, to say whether Mr. Bergh is the originator of this test or not, but I may say it was far from my intention to claim responsibility for the origin of it (in my first letter I stated it was fairly well known), as a somewhat similar system is described by Raphael in his "Localisation of Faults." My object in writing my first letter was more to point out the advantages of the supply current where obtainable for testing with this method, in preference to secondary cells or a portable motor-

generator, as the supply pressure is usually higher than that obtained from cells, &c., and higher resistance faults can therefore be localised.

I thank Mr. Bergh for his solicitude on my behalf, in saving what he is pleased to term a lot of valuable time, and, while recognising his good intentions, would beg to point out to him that his hint in this case is unlike the time, inasmuch as it is not very valuable. If he will refer to my fig. 2 in your issue of the 17th ult., and connect to it a few imaginary consumers, he will, I am sure, be of one mind with me when I say it is absolutely imperative (if the test is to be a success) to draw those consumers' main fuses, or open their main switches, as, unless this is done, any lamps or other current-consuming devices which happen to be on will act as a shunt to his ammeter, and also affect his millivoltmeter or galvanometer readings.

In his statement No. 2 he repeats part of my first letter: "The resistance of the fault does not enter into the calculations," with the addition, "in any case whether it be high or low." What does he mean by high? Raphael refers to faults of a megohm or some thousands of ohms resistance, and I have had experience with faults which on the application of an ohmmeter record over 10,000 ohms, but when tested with 2,000 volts, would immediately blow the fuse. The effect of this, in some cases, is only to add a few 1,000 ohms to the resistance, and by repeating the dose the cable clears itself only to break down again in, perhaps, a week or may be a year. For faults of this description the test loses its practical value, inasmuch as the readings obtainable are too small to be recorded by any other than delicate laboratory instruments, which would hardly stand the rough usage that is so often meted out to portable instruments.

He also states that: "If the resistance of the fault be *very* high, the testing current can be obtained by cutting the bank of lamps completely out of circuit, and applying the full voltage to the faulty cable." This is of little use, as the resistance of the lamps would be negligible compared with that of the fault, and practically the full supply voltage would be on the faulty cable with the lamps in circuit.

With reference to Mr. Bergh's statement No. 3. When I remarked that secondary cells were necessary when the supply current was not available at both ends, I, of course, assumed that no loop of any description could be devised. My figs. 2 and 3 both show a loop in use, fig. 2 through one of the sound conductors and fig. 3 through the trolley wires.

I have not had the pleasure of reading the *Electrical Magazine* of October and November, 1904, but have been informed since writing my first letter that this method was described (with testing current obtained from cells and a separate test wire) in the "Questions and Answers" column in one of your contemporaries of February 21st, 1902, by contributors who sign themselves "R. S." and "B. C. H. J."

**B. S. H.**

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In the descriptions of the methods for the "Localisation of Faults in Cables," I notice that the resistances of faults are often spoken of as being "high" or "low," but the actual resistances are seldom given.

I should be much obliged if some correspondent would give some actual values of the resistances of faults found on electric light mains.

**Precision.**

Wigan, *April 10th*, 1905.

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**A.C. v. D.C.**

I am pleased to note that there are some electrical men whose natural desire to pulverise a correspondent does not outrun their judgement or cause them to subvert facts.

In view of what has already appeared, I am astonished that no one has arisen to proclaim D.C. theory more complicated than A.C., and thus fittingly complete the case for the opposition.

**W. Talboys Wheeler.**

Tunbridge Wells,
*April 11th*, 1905.

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["Velox" wants the names and addresses of persons (English preferred) who would be likely to entertain a scheme for a new tube electric railway.—Eds. E.R.]

## DINNER TO MR. T. C. MARTIN, OF NEW YORK.

On Saturday evening last at the Café Royal, Mr. T. Commerford Martin, of New York, was entertained at dinner by his British friends—a representative gathering of 40 electrical men. Mr. R. Kaye Gray presided, and, in proposing Mr. Martin's health, expressed the gratitude which was felt for the many kindnesses received by visitors from England at Mr. Martin's hands. He further referred to the hospitality and kindly care shown by the members of the American Institute to their English visitors last autumn. There was naturally a desire on the part of himself and those associated with him to take the opportunity now afforded by Mr. Martin's brief visit to give expression to their gratitude to Mr. Martin himself and those other friends in the United States whom he, on the present occasion, represented. Prof. Ayrton also spoke to the same toast, and, in doing so, quoted from a speech made by his daughter a day or two previously. Mrs. Zangwill, unaccustomed, perhaps, to active participation in after-dinner oratory, had been impressed with a story of a citizen who had sought, in African travel, some relief from the anxieties of after-dinner speeches. Roaming in the forests he observed a lion approaching. Unarmed and as little fleet of foot as the average London diner-out, there was no alternative but to face the situation with calmness and resignation. As the African lion approached, the London lion ejaculated, "Well, thank goodness, I shall not be called upon to make *his* after-dinner speech." And then, to show how little terror after-dinner oratory had for him, the professor eloquently seconded Mr. Gray's remarks, and related his many obligations to Mr. Martin and Mr. Martin's countrymen. In his reply, Mr. Martin expressed the pleasure which it gave him to meet his friends. He recalled the time when he first went to New York, and he tried to give some idea of what it meant to change one's nationality. It had taken him 15 years to bring his mind to it, but he evidently felt that his allegiance was due to the country which had given him his opportunity, even as the plant must own allegiance to the soil which has permitted the seed's development. Col. Crompton proposed "The American Institute of Electrical Engineers," and was followed by Prof. Perry. The toast was also understood to refer to the Sister Societies. Prof. Perry made an excellent and interesting speech; but, in responding, Mr. Siemens humorously complained that the Sister Societies had not been mentioned in it. It did not matter. We had two diverting speeches nevertheless. Mr. Gray expressed the indebtedness of the company to Mr. Wetzler, who had acted as secretary to the function, and in responding, Mr. Wetzler proposed the health of the Chairman, which Mr. Mordey seconded. With a "thank you" from Mr. Gray the formal proceedings terminated, to be continued informally some time longer by a diminished number but with undiminished enthusiasm. The occasion was one which will leave pleasant memories on all who attended.

## BUSINESS NOTES.

**The Edison Secondary Battery in Germany.**—The Deutsche Edison Akkumulatoren Co. is the title of a new company which has been formed in Berlin with a capital of £150,000 for the manufacture and sale of the Edison battery. The founder is Mr. S. Bergmann, of the Bergmann Electricity Co., assisted by the Deutche Bank and Herr F. Gunther, of Dresden, and among the members of the board of supervision appears the name of Mr. Thomas A. Edison. The production of the accumulator has already been commenced at the works of the German Garvin-Machine Co.

**Condensing Plant Contracts.**—During the month of March the Worthington Pump Co., Ltd., secured the following, among other contracts, for condensing plant:—

One complete condensing set to deal with 20,000 lb. of steam, for the Fulham Electric Light Station.
Three combined condensing sets, each to deal with 10,000 lb. of steam per hour, for Messrs. Lever Bros., Port Sunlight.
One condensing set (repeat order), for the Malta Dockyard.
One condensing set, for the Leeds Forge Co.; and an experimental set, for the Heriot Watt College, Edinburgh.
One complete condensing set, for Milan Electric Light Station.
One horizontal jet condensing set for use with Rateau turbine, for the Hucknall Torkard Colliery.
One barometric condensing set, for South Wales.
Three oil separators each to deal with 20,000 lb. of steam, for the Belfast Tramways (repeat order).
One separator, for Pekin Electric Light Station.

**Dissolutions and Liquidations.**—The Electrical Treatment Association, Ltd., of Liverpool, is winding up voluntarily with Mr. H. A. Maw, 4, Harrington Street, Liverpool, as liquidator.

The Rangoon Electric Construction Syndicate, Ltd., meets on May 8th at 3, Princes Street, Westminster, to hear an account of the winding up from the liquidator (Mr. F. C. Ridley).

Messrs. H. W. Sutton and G. A. Benton (H. Sutton & Co., electrical engineers, of Muswell Hill, N., and Windmill Street, Tottenham Court Road, W.) have dissolved partnership. Debts are to be attended to by Messrs. Miller & Smith, 3, Salter's Hall Court, E.C.

The *London Gazette* gives notice that the public examination of Max Margowski, in *re* Automatic Telephone Co. (1903), Ltd., is to take place on April 17th at Carey Street.

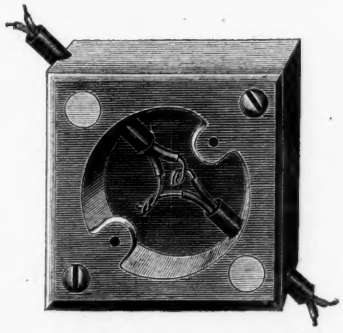
**Electric Pumping Plant.**—A high-tension electrical pumping plant with high-lift centrifugal pumps, has just been completed at Messrs. Bolckow, Vaughan & Co.'s Shildon Lodge Pit, by the Electrical Co., Ltd. It is claimed that the plant is the largest of its kind installed in England.

**Motor-Boat Club.**—On the occasion of the visit of the French Fleet to Spithead, the British Motor-Boat Club is arranging an international motor-boat race to take place between the lines of the British and French battleships. The club has also arranged its opening meeting at Kingston-on-Thames, on Saturday, May 6th, when it is expected a large number of motor-boats will gather together. There will be a dinner in the evening at the Sun Hotel, Kingston.

**Correction.**—In our article on "The Agricultural Hall Motor-Car Show," on page 549 last week, it was stated that the High Tension Co., Victoria Works, Charlton, S.E., make a multi-cylinder coil capable of giving a 10-in. spark. This, we are informed, was a mistake. The 10-in. spark coil is for X-ray and wireless telegraph purposes, and quite distinct from the four-cylinder ignition coil.

**Cox-Walkers.**—The firm of Cox-Walkers, of Darlington, has been placed upon the Admiralty list of manufacturers and contractors for supplying electric light switchboards, tell-tales, &c. We have received a souvenir giving photographic views of a number of country mansions into which the firm has put electric lighting, telephone or fire-alarm installations.

**New Iron Patera.**—An improved form of cast-iron patera has been devised and protected by Mr. H. Bailey, of 54, Blackburn Road, Accrington. The patera is of square shape, completely closed at the back; holes are provided at opposite corners to admit lead-covered twin wires, and cavities in the casting permit of a leaden seal being poured in round the lead sheathing, thus ensuring the electrical continuity of the latter. The central part of the patera forms a sealing chamber, which is filled with wax after the conductors have been prepared for connection to the ceiling rose or switch. Tapped holes for fixing the latter are provided, as shown in the figure, and it will be seen that, thanks to the holding-down screws being outside the base of the switch or rose, a series of roses can be completely assembled, together with



Cast-Iron Patera.

the switch controlling them, and the wiring, all ready for screwing up. On wooden patera is required. In the case of cotton mill installations, where the lamps are often in straight rows of four to eight, each group, complete with pendants, can be prepared in advance, and erected by two men in half an hour, thus economising time and ensuring the minimum of interference with the running of the machinery. Besides economy of time, economy in cost is claimed for the system. The pateras are obviously intended for use with lead-covered wire; when freely exposed this is not liable to puncture by nails, but where this danger exists, close-joint tubing can be used to protect the conductors. The system appears to possess many advantages.

**Bankruptcy Proceedings.**—A receiving order has been granted on debtor's own petition against Harry Thorpe, electrician and engineer, 11, Bartholomew Villas, Kentish Town Road, late of 235, High Holborn, and Holloway. The first meeting of creditors and the public examination are to take place on April 19th and May 16th respectively at Carey Street, W.C.

**Catalogues and Lists.**—Messrs. Siemens Bros. and Co., Ltd., have sent us copies of their latest publications, referring to the Murnau Ober-Ammergau Single-Phase Railway, the "Vilex" completely enclosed watertight electric bell, and a well-illustrated pamphlet describing the electric steering-gear of the turbine steamer *Manxman*.

We have received from Messrs. J. H. Holmes & Co, Portland Road, Newcastle-on-Tyne, a copy of a very nicely got up and revised price list of their Lundell and Castle D.C. motors. Full particulars and many illustrations are contained therein. The list is divided into sections, in which details and prices, &c., of machines, ventilating fans, newspaper printing and other motor-driving applications are given. We have also received a list of installations giving particulars of the generators and motors the company have supplied to newspapers, printers and paper mills.

A catalogue has come to hand from Messrs. Ferranti, Ltd, Hollinwood, illustrating and giving particulars of their 11 in. round type moving-coil instruments for continuous currents.

Messrs. Gent & Co, Faraday Works, Leicester, have sent us a descriptive catalogue of their patent silent impulse clocks. These clocks are fitted with the firm's patent weak battery warning bell, and can be fitted with a chronographic attachment, enabling Greenwich time to be set every 24 hours. Full particulars of these electrically-driven and controlled clocks are contained in the list. Another list fully illustrating and describing the "Regent" telephones is also to hand.

The Electrical Co., Ltd, 121—125, Charing Cross Road, W.C., have sent us a copy of their specification of single, two and three-phase motors.

The Edison & Swan United Electric Light Co, Ltd., have sent us copies of three new leaflets they have just issued describing their "Radio-Lite" lamp, "Triton" extension box, and "Clincher" plug.

An interesting and well-illustrated pamphlet has been sent to us by Messrs. Ernest Scott & Mountain, Ltd., of Newcastle-on-Tyne, describing some electrical machinery they have made for use in shipyards, docks and pontoons, &c.

Two more well-illustrated pamphlets, Nos. 178 and 179, are to hand from the British Thomson-Houston Co., Ltd, Rugby, entitled "Voltage Regulators for Alternating and Continuous Current Generators," and "Generating and Sub-station Switchgear" respectively.

The United Flexible Metallic Tubing Co., Ltd., of Ponder's End, have issued an exceedingly well got up pamphlet, which deals very fully with their speciality and illustrates its many applications.

The Electric and Ordnance Accessories Co, Ltd., Stellite Works, Birmingham, have sent us three trade leaflets, illustrating motor-starting panels, electrical accessories and the "Stellite" radiators.

From Messrs. Cecil Hodges & Co., Balfour House, Finsbury Pavement, E.C., we have received a picture postcard which illustrates one of their switch fuses, and also a moving-coil voltmeter.

Messrs. Johnson & Phillips have issued a new price list of their "Ark" lamps, a copy of which we have received, together with two illustrated postcards giving prices of their single enclosed "ark" lamp and their 12 in. desk fans.

From Messrs. Jules Geraud, Leclerc & Co., patent agents, of Rio de Janeiro, we have received a copy of the terms, conditions, &c., for obtaining patents, trade marks, &c., in all the republics of Latin America.

The Simplex Steel Conduit Co., Ltd., have sent us one of their embossed trade mark leaflets, which shows a few of their most used fittings, and also gives a short classified list of their conduits and accessories.

**German Electrical Machinery Imports and Exports.**—Only 101 tons of foreign electrical machinery were imported into Germany during January last, as compared with 110 tons in the corresponding month of last year. There has also been a decline in the exportation of German electrical machinery—from 1,316 tons in January, 1904, to 996 tons in January last.

**Australian Patents.**—Messrs. W. P. Thompson & Co. write:—"Through the kindness of a member of the Australian Parliament, we have received information that the decision of the Comptroller there not to convert ordinary State patents into Commonwealth patents has been upset, and that now the obvious meaning of the Patent Act, namely, that any State patent can be at once changed into a Commonwealth patent, and thus the renewal fees on the various State patents can be avoided, is maintained; and, further, a patent for a single State patent is now extended to the entire Commonwealth of Australia at a cost of little if any more than paying a single tax on one of these patents. This decision appears to be final, and will be of great interest to all those who have Australian patents."

**Football.**—The return match between teams representing the Witton Works of the General Electric Co., Ltd., and Robertson Electric Lamps, Ltd., Hammersmith, was played on Saturday, 8th inst., on the Witton ground, and resulted in a victory for the former club by three goals to none. After the match the Witton club entertained the visitors at dinner at the Colonnade Hotel, Birmingham, the toasts of the "Robertson Football Club" and the "Witton Works Football Club" being proposed by their presidents, Mr. Railing and Mr. C. Wilson, both of which received a hearty reception. A smoking concert held afterwards was contributed to by the members of the G.E.C. works and staff, augmented by the works orchestra.

**Electrical Driving of Textile Mills.**—The worsted-spinning mills of Messrs. Thomas Burnley & Sons, Ltd., Gomersal, have recently been completely equipped with electric motors, and the whole mill is now driven electrically. The electrical energy is being purchased from the Yorkshire Electric Power Co., and therefore the boilers and main engines of the mill will no longer be required. Now that the Yorkshire mill-owners can obtain a cheap supply of electricity "on tap" from the power company, Messrs. Burnley's example will doubtless soon be followed by others.

**Electric Fire Engine.**—An electric motor fire engine is to be added to the equipment of the fire brigade at Leipzig.

**For Sale.**—On April 19th Messrs. Scottorn & Smedley will sell an electrical engineer's stock-in-trade by auction at Nottingham. See our advertisement pages.

**Book Notices.**—*Automobiles : Vapeur—Pétrole—Electricité.* By H. Rodier. Paris: *Annuaire Technique*, 64, Rue de la Victoire. London: Dulau & Co. 1905. Price 12 fr.—This is an encyclopædic work dealing with every part of an automobile, and is probably the most comprehensive treatise on the subject yet published. The rapid advance of automobilism has raised up a vast body of experts and professional men who no longer, as in the earlier days, require simple works of the popular type, but call for highly technical and detailed treatises such as the excellent volume before us. The aim of the author, assisted by a committee of distinguished engineers and automobilists of France and Italy, has been to cover every sort and kind of automobile vehicle designed for use on ordinary roads, in all its parts, dealing with the theory as well as the actual details of construction. Commencing with the resistances to traction which have to be overcome by road vehicles, of which abundant data are given, with a lengthy exposition of the theory (including the inertia effects of the parts of the vehicle), the author passes on to the thermodynamics of steam and gas engines, carburettors, explosion motors, electric ignition, transmission gear, axles, tires, &c., leaving nothing untouched. Electric batteries, motors, &c., are of course included. Nearly half the volume is thus taken up, the remainder being occupied by descriptions of the principal types of vehicle manufactured. The severely technical nature of the work may be gathered from the fact that, so far as we have been able to ascertain, not a single photograph of a complete car has been reproduced, the great majority of the illustrations being line drawings, and the outline of the body being merely dotted. A fairly comprehensive index is provided. And now, having explained the objects and value of the work, we must point out what, in our opinion, is its fatal defect. It is confined to French automobiles. There was a time when France stood pre-eminent in this branch of engineering industry, and when to describe all the French types was to describe all automobiles; but that time has passed away. Automobile experts will support us when we say that motor-cars of British design and manufacture can be obtained which are unexcelled by those of any foreign nation; to ignore their existence may possibly be patriotic—but it is an unfair proceeding, unworthy of the author of this work.

*Standard Specification for Electrolytes in Storage Batteries.*—Messrs. R. W. Vicarey and Co., storage battery experts, of 91, Foregate Street, Stafford, are issuing a copyright standard specification of the quality of acid and water for use as the electrolyte in storage batteries. In this the physical characteristics of the acid and water are specified, and the maximum permissible percentages of various foreign substances, both metals and acids, which may be present in them, are defined. Amongst other items, the authors point out the excessively detrimental effects of ammonia and other alkalis upon the life of the plates.

"Catalogo de la Exposicion Permanente y Museo Industrial de la Sociedad de Fomento Fabril." Santiago de Chile: Litografia y Encuadernacion Barcelona Moneda, entre Estado y San Antonio.

"Memorandum on the New German Commercial Treaties and the New German Tariff." London: The Tariff Commission, 7, Victoria Street, S.W.

"Experimental Researches on the Flow of Steam Through Nozzles and Orifices." By A. Rateau. Translated by H. Boyd Brydon. London: Archibald Constable & Co., Ltd. 4s. 6d. net.

"The Motor Manual." Seventh edition. London: The Temple Press, Ltd. 1s. net.

"Modern Iron Foundry Practice," Part II. By Geo. R. Ball. Manchester: The Technical Publishing Co., Ltd. London: Simpkin, Marshall & Co., Ltd. 3s. 6d. net.

*The Physical Review*, March, 1905. Lancaster, Pa., and New York and London: The Macmillan Co.

*The Australian Official Journal of Patents*, 1905. Nos. 1 to 7. Melbourne: By Authority; Robt. S. Brain, printer and publisher. Single copies, 6d.

**Exports of British Electrical Machinery.**—An active state of affairs continues to prevail as regards the export trade of the country in electrical machinery. The value of the shipments last month is returned at £48,522, as against only £31,511 in March, 1904; while for the first three months of the year they have amounted to £168,764, an increase of £73,461 over the corresponding quarter of 1904.

**Trade Announcements.**—Messrs. Chas. Hatton & Co., of 107, Upper Thames Street, E.C., and Mr. Edward Lomer, 12, St. Mary Axe, E.C., have been appointed sole agents for Great Britain and Ireland for the German Gas Tube Export Syndicate, which controls the entire output of a large number of works in Germany making wrought-iron gas, water and steam tubes up to 4 in. diameter, &c.

In future all communications for Arc Lamps, Ltd., are to be addressed to the works, 44, St. Paul's Crescent, Camden Town, N.W.

We are asked to notify that all communications for the Sheffield Corporation Tramways Department should be addressed to Division Street, Sheffield.

The Southern Engineering Co., of Dublin, have opened an establishment at 20, Marlboro' Street, Cork. The repair and maintenance of electrical and mechanical machinery, telephone and bell installations, &c., are special features of their business.

## LIGHTING AND POWER NOTES.

**Aberystwyth.**—The Chiswick Electricity Supply Corporation has intimated to the Corporation that the company would be prepared to consider any proposal by the Corporation to acquire the electric light undertaking at Aberystwyth.

**Andover.**—At a meeting of the T.C. on April 6th, it was reported that the draft prov. order for E.L. had been settled, as well as a clause for permission to transfer the order to the local gas company, on the latter obtaining Parliamentary powers to accept the transfer on becoming a registered company.

**Birkdale.**—The E.L. Order has been extended to the added area of Ainsdale, which has just been merged in the township of Birkdale. The E.L. Co. contemplates laying a main to supply Ainsdale.

**Blackburn.**—The T.C. has resolved to raise a loan of £24,000 for electrical purposes, by the issue of nominal debentures.

**Blaydon-on-Tyne.**—At a meeting of the U.D.C. on the 6th inst. an agreement was sealed with the County of Durham Electrical Power Distribution Co., Ltd., as to the lighting of the district and the transference to the company of the undertaking authorised by the Blaydon E.L. Order, 1902. An attempt was made to have rescinded the former resolution formally accepting the terms of the company, the ground of objection being that the company would not undertake to introduce tramways into the district, which certain members wished to be a condition to the handing over to the company of the lighting undertaking. After much discussion the suggestion was rejected, and the agreement ordered to be sealed.

**Bradford.**—From the *Bradford Daily Telegraph* we learn that tenders amounting to just over £10,000 have been let—subject to the approval of the C.C.—for work in connection with the introduction of the new three-phase system. The Westinghouse Co. is to provide the generators.

**Brighton.**—At a T.C. meeting on April 6th, the Lighting Committee reported that Mr. A. Wright had written, stating that he had recently become a direct shareholder in the Reason Manufacturing Co., Ltd., and, in all probability, would shortly become a director. After approaching Mr. Wright, the committee resolved that he be engaged as consulting electrical engineer to the Corporation for six years from April 19th, 1905, to superintend all present and future capital expenditure in connection with the electrical undertaking, at a salary of £600 per annum, and that he be paid a further sum in any year of the said period, in which a profit exceeding £5,000, after payment of all debt charges, interest, and working expenses is made, equal to 5 per cent. on the amount of such profit.

**Burnley.**—The T.C. on April 6th decided to apply to the L.G.B. for a loan of £6,105 for the purchase of a 500-KW. steam dynamo for the electricity works.

It was also decided to reduce the charges for energy and the rental of arc lamps as under:—For traction purposes, from 1·5d. to 1·45d. per unit; for lighting, from 4d. to 3½d.; for motors and heating, from 3d. for the first hour and 1d. afterwards, to 1¾d. and 1d.; for public lighting, from 3d. to 1½d.; for arc lamps, from £1 to 15s. per annum per lamp.

**Derby.**—The estimated expenditure on capital account for the year ending March 31st, 1906, was presented by the E.L. Committee recently. This estimate was prepared by the engineer, and amounted to £9,600. £4,600 was required in connection with the extension of plant and £3,000 for mains. This was approved by the Council.

**Eastbourne.**—The gas company has threatened to oppose the application of the T.C. for a prov. order to supply energy to Willingdon, unless the T.C. amends the Eastbourne order by inserting a retrospective clause into the Willingdon order, compelling the Council at the end of the third year to reconsider, and if necessary, revise the price of energy, so that so far as is reasonably practicable no rate will be required for the purpose of defraying the future expenses of the undertaking. Although the matter is to be submitted to the arbitration of the B. of T., the gas company reserves to itself the option of carrying its opposition to the House of Lords. The T.C. is willing to insert the clause, minus the retrospective power, into the Willingdon Order.

**Enniscorthy Asylum.**—In connection with the short note in our issue of 31st ult., we have since been informed that Messrs. Porte & Co., of Dublin, were the contractors for the main switchboard, the switchboard at the mill, and the whole of the wiring in connection with the scheme. They also secured the contract for the underground mains, which were not included in the original specification.

**Fazoum.**—The High Municipal Commission is considering a scheme for lighting Medinet-el-Fazoum by means of electricity with the help of waterfalls.

**Durban.**—In connection with the extensive harbour works now being provided at this progressive South African port, Messrs. Stothert & Pitt, of Bath, have constructed for the Natal Government, under its consulting engineer, Mr. H. G. Humbie, a large overhead electric travelling crane. From the *African World* we obtain the following particulars. It is designed to handle concrete blocks up to 20 tons, and to cover an unusually large area. The length of the gantry, which has been constructed by Messrs. J. Westwood & Co., of Millwall, is 1,500 ft., and the crane span 135 ft. 8½ in. between centres of running rails. The main girders consist of a single web girder braced to a subsidiary girder, which is further stiffened by means of a chequer platform, and laterally by diagonal stays. The under girders are fish bellied, 8 ft. deep at the centre. The end carriages are each mounted upon two pairs of double flanged wheels, each pair being carried on a swivelling bogie, and so arranged as to equally distribute the weight over all wheels. There are two lift speeds—10 and 20 ft. per min. —the cross traversing speed being 120 ft. per min., and the travelling speeds, 100 or 300 ft. per min. The lifting and traversing motions are operated by separate motors of 20 and 12 B.H.P. respectively, and the travelling motion by two 40-B.H.P. motors, arranged for series-parallel control.

**Fochabers.**—Progress is being made with the canal from the River Spey, which is to provide the power to drive two turbo-generators to provide electric light to Gordon Castle and Fochabers. The whole of the work is in the hands of Messrs. Drake and Gorham. When it became known that the Duke of Richmond intended to light the castle by means of electricity, the people approached him to consider a supply for the district. The Duke acceded to the request, and has decided to provide electric light at a charge of 5s. per 16-C.P. lamp per annum, without any further cost. The canal from the Spey will be about a mile long, and about 12 ft. broad and 4 ft. deep.

**Heckmondwike.**—Although the Heckmondwike Urban District Council has been supplying electricity since the latter part of 1901, the formal opening of the works did not take place until Saturday last. Members of the Council and officials, with representatives of firms who have supplied the plant, met at the station in the afternoon. In the course of the proceedings it was stated that the works were opened with 39 consumers, and connected with a total equivalent of 2,804 8-C.P. lamps. On March 31st of this year, 20,467 equivalent 8-C.P. lamps were connected, and the number of consumers had largely increased. Energy for power is now supplied to 57 motors, aggregating 331 H.P. The maximum load at the end of last month was 541 KW. In 1902 24,598 units were sold.

**India.**—DELHI.—Licences for the supply of electrical energy within the municipality have been granted by the Panjab Government to Mr. Arthur Grey, barrister of Lahore, and the firms of Messrs. John Fleming & Co. and Messrs. Killick, Nixon & Co., of Bombay. The licensees are required to pay the Municipal Committee in respect of any tramways constructed a yearly rent of Rs. 800 per mile of double track, and Rs. 500 per mile of single track.

**Ipswich.**—The B. of G. has been advised to add to the electric light plant at the workhouse a 40-H.P. gas engine, a dynamo, gas producing plant for existing and new gas engine, two electric motors, a booster and alterations to the switchboard, at an estimated cost of £1,220. It is estimated that, by the use of the gas producing plant, there will be a saving of £111 per annum.

**Italy.**—Another central power station has recently been inaugurated at Zogno, in the Val Brembana.

The new hydro-electric installation of Turbigo, of the Société Lombarde, for the distribution of electric power, is finished. It includes five units of 1,500 H.P. Water is taken from the "Naviglio Grande," utilising a fall of 8·20 m. on four Riva-Monneret turbines coupled directly to fly-wheel alternators of Messrs. Gadda, Brioschi and Finzi's make.

A new company is to be formed at Carrara for the construction of a hydro-electric plant near Monteverde.

The limited company, Joh. Jacob Rieter & Co., of Winterthur, has solicited a concession of water from the Doire Baltée for electric traction purposes on the Col du Ferret Railway on the Italian-Swiss frontier. The hydro-electric installation will be constructed at Palu and will utilise a fall of 200 m.

**Knutsford.**—The B. of T. has revoked the Council's 1899 prov. order.

**Leicester.**—The T.C. has decided to supply energy at 4d. per unit to consumers using over 1,500 units per quarter. This is 1d. less than the ordinary charge. The electrical engineer has been instructed to make inquiries as to the probable demand for energy by manufacturers and others for power, with the object of revising the tariff.

**London.**—HAMMERSMITH.—A difficulty has arisen between the L.G.B. and the B. of G. relative to the electric wiring of the workhouse buildings. Acting on expert advice the guardians declined to accept the lowest tender, and apparently some ratepayer has drawn the attention of the L.G.B. to the fact. At the meeting of the B.G. on April 5th a statement that the lowest tenderer had not previously done any electrical work for public bodies was denied, and several members urged that the lowest tender should be accepted, as the person tendering was fully competent to carry out the work. It transpired that the L.G.B. had declined to receive a deputation of the Guardians on the subject, and it was decided by nine votes to seven to again request that the deputation should be received.

HACKNEY.—The L.C.C. has agreed to lend the B.C. £11,083 for electric lighting and street lighting.

**Macclesfield.**—At the meeting of the T.C. on April 5th, it was reported that the B. of T. had, for the present, decided not to grant the application of Messrs. Foote & Milne that the E.L. order should be revoked; but it was intimated that if the Corporation had not taken steps by the end of the present year to carry out the order, the Board would not allow it to remain in force any longer. The Council has now decided that it must take steps to provide an electrical installation for the town, and Mr. Woodward, electrical engineer, is to endeavour to arrange the basis of a scheme.

**Newport.**—In reference to the recent application by the Corporation for sanction to borrow £17,825 for E.L. purposes, the L.G.B. states that it will comply with the application so far as it relates to the borrowing of £8,445. The amounts not included are £8,200 for further extensions to the new power station, and £1,180 for works in connection with the new sub-station at Stow Hill. The Board states that in regard to the former sum, applications should be made to the B. of T. for consent to that amount; in regard to the latter, it would defer consideration until the agreement with the B. of G. in respect to the site of the sub-station has been come to.

Two outbreaks of fire occurred recently in the bunkers at the power station through spontaneous combustion, and on the recommendation of the electrical engineer, the Corporation has resolved to obtain some 4 in. gas piping for ventilating the bunkers.

**New York City.**—The report of the special committee appointed on December 30th last to consider the possibility of installing a municipal plant for public lighting was made public in the New York *City Record*—a publication analogous to the *London Gazette*—on March 14th last. The document in abstract is as follows:—

On January 1st, 1905, there were in these two boroughs (Manhattan and the Bronx) a total of 5,250 arc lamps and a total of gas and incandescent lights equivalent to 210,000 16-C.P. incandescent lamps. These were distributed in 640 separate buildings and places. We estimate that by the time this plant is ready for operation, at least 6,000 arc lamps will be required, and a connected load equivalent to 250,000 16-C.P. lamps, requiring a power-plant capacity of 10,000 KW. Our estimates are based on a 60-cycle, A.C. supply system for both arc and incandescent lighting. We propose to use a 7·5 ampere arc lamp in the principal streets and avenues.

COST OF CONSTRUCTION.

| | | |
|---|---|---|
| Total cost of a power station with a capacity of 10,000 KW., including coal storage, coal-handling apparatus, building, complete boiler plant equipment, engines, generators, switchboards, interest during construction, but excluding land.. .. | $1,250,000.00 | (£257,731) |
| Total cost of high-pressure cables, sub-station buildings, transformers, switchboards, arc-lighting circuits, centres of distribution for incandescent lighting, lamp-posts, lamps, meters, and all appliances necessary to make a complete operative plant up to and including the lamps, including the cost of land, but excluding the cost of the main duct system, all for a capacity of 6,000 450-watt arc lamps in Manhattan and The Bronx, and for 250,000 equivalent 16-C.P. incandescent lamps .. .. .. .. .. | 2,850,000.00 | (£591,752) |
| Total cost of the complete system .. | $4,100,000.00 | (£849,483) |

COST OF OPERATION.

| | | |
|---|---|---|
| *Arc Lamp.*—We estimate that the total annual cost of operating a 7·5-ampere enclosed A.C. arc lamp for 4,000 hours per year, including all generation and distribution costs, lamp repairs, carbons, trimming, inspection, globes, insurance, management expenses, depreciation at 7·5 per cent., and interest at 3·5 per cent. on the total investment, will be .. .. .. .. .. .. | $75.40 | (£15 9s. 3d.) |
| *Incandescent Lamp.*—The total cost per lamp per KW.-hour, including all charges, will be .. .. | 5·15 cents | (2·548d.) |
| *Total Cost of Operation.*—The total annual cost of operating this plant for 6,000 arc lamps and 250,000 equivalent 16-C.P. lamps, including all operating expenses, depreciation at 7·5 per cent., and interest at 3·5 per cent., will be .. .. | $906,000.00 | (£19,099 7s. 7d.) |

These estimates include neither the cost of construction of ducts for cables, nor any rental charge for duct space. These items have been omitted under instructions that the City Council has the right to use all the duct space that it requires, and free of all charges.

As previously reported, the Board of Aldermen has recently appropriated a sum not exceeding $600,000 (£120,000) for the purchase of a site for a central power station, preferably on the East River. The estimates of the Committee presented above have been much criticised, Mr. Ernest H. Davis, president of the National Electric Light Association, calculating that the cost per arc lamp per annum should be $121.49, and the cost per KW.-hour for the incandescent lamps should be 12.88 cents. The price hitherto charged for public arc lamps by the local companies has been $146, but after much asseveration that this was the lowest possible quotation, the tenders for the remainder of the present year have been reduced to $120. Pending action by the City, this price has been rejected.

**Norwich.**—A L.G.B. inquiry was held on the 4th inst. into the application of the T.C. for power to borrow £30,000 for electrical purposes. There was considerable opposition to the proposal.

**Reading.**—From a local source we learn that the Mayor will open an electrical exhibition at Vastern Road on Easter Monday. The exhibition will cover 30,000 sq. ft. of floor space, a large amount of machinery will be installed, and all the latest developments of electricity as applied to heating, lighting and motive power are to be shown in operation.

**South Africa.**—A firm of electrical engineers are negotiating with the municipality for lighting the town of Ficksburg by electricity.

**Stalybridge.**—The Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board has, in order to encourage the use of electricity by long-hour customers, decided to adopt the demand indicator system, the prices being 4d. per unit for the first two hours per day throughout the year, or 2½ hours between September and March, and 1½ hours between March and September, and 2d. per unit for all energy consumed afterwards.

**Stourport.**—At the meeting of the U.D.C. on April 5th a petition, largely signed by residents and tradesmen, was received, urging the Council to take steps to secure a supply of electricity for the district. It was suggested that the Council should ask the Kidderminster E.L. Co. to apply for powers to undertake the supply. The memorial was referred to a committee for consideration.

**Thornhill.**—The Yorkshire Electric Power Co. has written to the U.D.C. offering to install 160 electric lamps of about 20 c.p. at a total cost of £192 per annum for public lighting. The Council has requested the company to erect a trial lamp.

**Tipton.**—The B. of T. has intimated to the local authority that it has revoked the electric lighting order granted in 1902.

**Walsall.**—In order to meet the increased demand for the electric light, it has been decided to purchase another transformer for the Park Street sub-station and to remove the one in Park Street to the Cross Street sub-station. To cover the cost of the necessary works, application is to be made to the Local Government Board for a loan of £1,350.

**Willesden.**—A report from the resident electrical engineer as to the desirability of revising the present scale of charges for the supply of energy for motors having been considered, it was resolved (1) that a flat rate charge of 1½d. per unit for power be made where the supply is automatically switched off at dusk; (2) that a flat rate charge of 1½d. per unit be made for power available at any time; (3) that a scale of charges be framed for large power users, under which the price will vary, both with the load factor of demand and the total number of units consumed. The L.G.B. has sanctioned a proposed loan of £2,000 for the purchase of electric motors. The resident electrical engineer is to report whether there is any demand in the district for motors on the hire-purchase system, and also to frame a scale of charges in connection therewith.

**Woodford.**—The U.D.C. has decided to apply to the B. of T. for a prov. order authorising the Council to supply electricity for public and private purposes.

**Yorkshire Electric Power Co.**—The Yorkshire Electric Power Co. (whose generating station at Thornhill is approaching completion) has power to carry mains through Dewsbury, but permission to supply private consumers within the borough without the consent of the Corporation is not admitted. An application has been made to the Corporation by Messrs. Haigh Bros., colliery proprietors, Dewsbury Moor, for permission to take a supply from the company, but consent has been refused.

## TRAMWAY AND RAILWAY NOTES.

**Bath.**—The *Daily Telegraph* says:—"Six motor-omnibuses have been ordered by the electric tramways company for use in the hilly districts."

**Bury.**—The working of the Corporation tramways for the past year was reported at the meeting of the Town Council last week to have resulted in a credit balance of £434 10s. This sum the Council directed to be carried to the credit of the reserve fund. Councillor Hall, in moving the adoption of the report, said the estimate last year was that the tramways would require a rate in aid of £2,700. This had not been required, and the money would go to the Education Committee, thus saving an education rate of nearly 3d. in the £. The working expenses worked out at 5·36d. per car-mile. The Committee has arranged with the Salford Corporation to run through cars to Heaton Park during the summer, both from Bury and Radcliffe. Mr. Hall expressed a hope that the difficulty with Heywood would be overcome before long, to the advantage of both Corporations.

**Central London Railway.**—Considerable inconvenience was caused on Tuesday evening through a stoppage of the Central London service for about an hour, the cause being a fusion of wires at the sub-station at Notting Hill Gate. There have been various reports published in the Press regarding dense volumes of smoke and consequent alarm. When the service was resumed the utmost difficulty was experienced in dealing with the rush of traffic, and at times booking had to be stopped.

**Chili.**—A Bill has been passed by the Senate granting permission for the construction of an electric railway, which, starting from the Port of Valparaiso, will pass through the Casablanca and Curacavi valleys, and communicate with Santiago by the west, having a branch line connecting the Curacavi valley with the town of Nelipilla. The length from Valparaiso to Santiago will be 143 kilometres (about 89 miles). All the materials, implements and machinery imported for the construction and exploitation of this line are to be free of Customs duties.

**Coventry.**—The T.C. has decided to abandon the proposed legal proceedings against the local electric tramway company for delay in the construction of the tramways in Albany Road.

**Darlington.**—At the meeting of the T.C. on the 6th inst. the Tramways Committee's recommendation that the experimental ½d. fares should be abandoned was discussed. It was eventually agreed to on the Mayor's casting vote, 10 voting each way.

**Dudley.**—The Corporation and the B.E.T. Co. have not yet settled their differences. A month ago it was stated in the Council chamber that the matters in dispute would be settled by the mediation of the Board of Trade. Since then, however, there have been new developments, and it is now confidently hoped that the differences will be amicably settled without such mediation.

**East Ham.**—Negotiations are proceeding between the T.C. and the Barking U.D.C. for the working by the former authority of the tramway from the eastern boundary in Barking Road to a point in East Street (opposite Ripple Road, Barking).

**Folkestone.**—The T.C. on April 5th, by nine votes to eight, decided "that inasmuch as Messrs. Griffiths & Co. do not give such guarantee as the Corporation requires, no further steps be taken in respect to the contract of Messrs. Griffiths & Co. for the tramway work." This decision shelves the electric tramway question for the time, and it is the intention of the T.C. to apply to the B. of T. for an extension of the tramway order. At Folkestone the use of the overhead trolley system is prohibited by Earl Radnor, Lord of the Manor, and the owner of the greater portion of the town.

**London.**—At the meeting of the London County Council on Tuesday, an expenditure of £26,000 was sanctioned in connection with the removal, lowering or diversion of mains, pipes and wires in respect of the proposed reconstruction of the Westminster-Wandsworth tramways.

The Highways Committee reminded the Council of the decision arrived at last December, to ask the Board of Trade to approve the details of the overhead system for the proposed tramways in Archway Road, from the Archway Tavern to the county boundary at Highgate Archway. Since then communications had taken place with the Middlesex County Council in regard to the working of the lines, pending the reconstruction for electric traction of the Council's northern tramways with which they would be connected. It was suggested that the new lines should be operated, in the first instance, as part of the light railways outside London, which had been constructed by the Middlesex Council up to the county boundary at Highgate Archway, and which would shortly be opened for traffic. The Committee intended to submit after the Easter vacation the terms of a proposed agreement with the Middlesex Council and its lessees, the Metropolitan Electric Tramways, Ltd., with a view to the working of the lines in the way indicated. In the meantime the Committee asked for authority to obtain tenders at once, in order that the work of constructing the new lines might be commenced as soon as possible.

The Council postponed for a week the consideration of a long report by the Highways Committee in reference to the proposed acquisition of the remaining term of the lease granted to the North Metropolitan Tramways Co. The report first deals with the difficulties which have arisen in connection with the putting into force of the electric traction clauses of the lease, and then proceeds to discuss the advantages of early reconstruction of the tramways for electric traction. As a result of further negotiations with the tramway company, the latter has expressed willingness to sell its interest to the Council as from April 1st, 1906, for the sum of £120,000, while the sum of £314,586 is the estimated valuation of the horses, cars, stable implements, harness and miscellaneous plant and machinery at the time of the proposed transfer. If the transfer is arranged, the Committee hopes that the reconstruction of the first section of the tramways may be begun immediately after acquisition so as to permit of this portion being ready for electrical working by Christmas, 1906. This is considered very desirable, in order to secure economy in working from the Greenwich station, which would supply the power for operating the lines.

In conclusion, the Committee submits various recommendations to give effect to the proposals to acquire the company's lease, rolling stock and equipment, and other property, on the terms already set forth, and also for the settlement of outstanding disputes between the Council and the company.

**Manchester.**—At an inquest held a few days ago on a little child, who was killed through running in front of an electric car, it was stated that the life-guard failed to act. The child was knocked over, and she became entangled in the mechanism beneath the front part of the car. When the car was examined after the

accident, it was found that a "set screw" was missing, making it impossible for the guard to act. Evidence was given by a tramway official, that every night the cars were examined. No defect had been noticed about this one. The only explanation that could be given, was that the screw had jolted out by the oscillation of the car. Such a contingency had not been anticipated, but means would be taken to see that such an accident did not happen again. The jury returned a verdict of accidental death, and exonerated the car driver.

**Middlesex.**—Sir H. Jekyll heard an application at the Board of Trade on the 5th inst., in support of an order promoted by the County of Middlesex, to enable the county authority to complete certain light railways, authorised in 1901, which had not been completed before the expiration of the period limited by the Order of 1904, and with slight alterations to bring the form of the order into harmony with more recent procedure. The *Morning Post* reports that Sir H. Jekyll, after hearing counsel, said the immediate question was whether it would be desirable or permissible to alter the general law, or make any variation in the general law of rating on an extension of time order. He doubted whether the Board of Trade would be disposed to entertain such an application of this particular kind of order, or whether the remedy might not be sought elsewhere. He would report the whole question to the Board of Trade for their full consideration; but his own personal opinion was that they would not feel themselves able to insert the clause desired in an extension of time order.

**Newcastle-on-Tyne.**—At the Northumberland Quarter Sessions on 6th inst. a series of appeals by the Tynemouth and District Electric Traction Co., against the assessments by the Tynemouth overseers in five parishes, was heard. Sir Edward Boyle, K.C., and Mr. Simey were for the appellant company, and Mr. Ryde and Mr. Mitchell Innes were for the respondents.

Sir Edward Boyle said the tramways went into five different townships, Clurton, North Shields, Cullercoats, Tynemouth and Whitley. The Bench would only be troubled with the assessment as a whole, and when that was settled the rest would be a question of apportionment. The old assessment was £895 gross and £677 rateable, and the new assessment was £4,938 gross and £2,549 rateable. The company objected to this latter figure, and the rateable value was reduced to £1,800, and it was against this that the company now appealed. They admitted that the rateable value of £677 was too low, and the company's witnesses suggested that it should be raised to about £1,000.

After a good deal of evidence had been heard, the Bench intimated that the assessment would be reduced to £1,367, plus £210 for the depôt, making £1,577 allowed.

**New York City.**—The New York City Rapid Transit Commissioners on March 30th considered revised plans and reports for new subways and elevated lines. The original tentative schemes, involving an estimated outlay of $250,000,000, have been reduced to an estimate of $50,000,000 less. In broad outline the plans provide for four four-track subways from the Battery to the Bronx, with routes so laid out as to prevent the creation of a monopoly and to attract rival bids. The routes selected are calculated to serve efficiently the pressing needs of both the east and west sides of the city. There are also to be four cross-town lines, either for cars or moving platforms. To connect Manhattan and Brooklyn there is a plan for a four-track subway from East New York to the Williamsburg Bridge, and then on the Manhattan side continuing to the new terminal of the Brooklyn Bridge. For Brooklyn also there are outlined five subways toward the suburbs. A special link is provided allowing of intercommunication between the new lines and the East River tunnel. Sundry elevated extensions are provided for the Bronx. There is no question but that any subways that may ultimately be constructed will be financed by private enterprise, and not, as in the case of the present subway, by municipal bonded funds. Construction will also be commenced within one year of the granting of the franchise.

**South Shields.**—The T.C. on Monday referred back to the Tramway Committee a recommendation that the tender of Messrs. Hurst, Nelson & Co., Ltd., be accepted for the supply of 10 electric cars, with Brill trucks, at £5,307, it being urged that the Council could obtain equally as good a truck of British manufacture.

**Spain.**—Electric traction is about to be adopted by the Grenada and Murcia Tramways Co. on its line from Murcia to Espinardo.

**Sweden.**—It is stated in the *Board of Trade Journal* that the Swedish State Railways Department is about to submit a project to the Riksdag for the purchase of the waterfalls near the principal lines, at the cost of 4,000,000 crowns. These falls would, it is said, furnish sufficient electric power for the running of the trains. For some time past the question of working the Swedish railways by electricity has been under consideration; and it is considered desirable that the Government should acquire the necessary water power in good time.

**West Ham.**—It was stated at the meeting of the Corporation on Tuesday that the total expenditure under Mr. Osman's tramways contract No. 1, the accepted tender for which was £55,092, amounted to £90,991. The chief items which accounted for the increase were:—New works outside original contract, £23,078; additional works (doubling of line) to original contract, £7,138.

## TELEGRAPH AND TELEPHONE NOTES.

**A Large Telephone Exchange.**—It is stated that the telephone exchange which is to be opened at Hamburg in the course of the present year will be the largest in Germany. The exchange will be able to deal with 50,000 subscribers on the double-wire system, although the existing connections only number 21,000. The telephone cables have all been laid underground, and on the starting of the exchange the present overhead wires connected with the old exchanges will be entirely removed from the roofs of the buildings throughout the city.

**Amazon Cable.**—The *India-Rubber World* quotes a Para paper to the effect that the Amazon Telegraph Co. has ordered a new cable extension, to be used in Amazonia, and expects to receive it shortly. This cable is destined to restore the other branches of its lines, and to improve as much as possible the electrical conditions of the line between Belem, Para, and Manaos, thus instituting a constant and regular service between the two cities of Amazonia.

**French Cables.**—The French Administration announces the opening to international service of the cable between Brest and Dakar. In order to secure the rapid transmission of traffic between Brest and South America, the South American Cable Co. have transferred their office in Senegal to Dakar.

**Manchester Corporation and the Telephone Agreement.**—The Manchester City Council unanimously resolved at its meeting last week to protest, by petition on memorial under the Corporate seal, against the proposed agreement, dated February 2nd, 1905, between the Postmaster-General and the National Telephone Co, "by which a momentous change in telephony throughout the country is proposed to be made, and particularly against the undue haste with which it is proposed to carry such agreement into effect, seeing that it becomes binding on August 31st next, if not disapproved by Parliament before that date." The Council also resolved that the Lord Mayor should arrange for the presentation of a petition to the Chancellor of the Exchequer and the Postmaster-General against the proposal.

**Marconi v. De Forest.**—The United States Court has given its decision in favour of the Marconi patent in a suit brought against the owners of the De Forest system for an infringement of patent by the American Marconi Wireless Telegraph Co. Certain claims in the Marconi patent, without which no wireless telegraphy is practicable, are declared valid by the Court, and to have been infringed by the defendant company.—*Pall Mall Gazette.*

**Portsmouth Telephones.**—The Telephone Committee will take steps to be represented and appear before the Select Committee of the House of Commons on the question of the Government taking over the undertaking of the National Telephone Co.

The borough treasurer recently inquired of the Committee if it was intended to pay off any portion of the suspense account during the current year, and he also reported that there was an available balance of £1,500 which could be placed on deposit. The Committee resolved that £614 5s. 8d. be paid off the suspense account this year, and that £1,500 be placed on deposit. It has been decided that a new toll rate be made—viz., £4 per annum for a maximum of 1,000 calls, and ½d. per call above that number, to take effect from March 1st as regards present subscribers. The charge for unlimited service is to be reduced from £5 17s. 6d. to £5 15s. per annum, to take effect from March 1st.

**Scarborough Telephones.**—The T.C. has received from the Postmaster-General an intimation that it is proposed to revoke the telephone licence granted to the Corporation, because no steps have been taken in the matter.

**Telegraph Cable Imports.**—The value of the foreign telegraph cables and apparatus connected therewith imported into this country during March last is returned at £2,911, bringing up the total for the first quarter of the year to £20,059, as compared with only £9,246 in the corresponding three months of 1904.

### Telegraphic Interruptions and Repairs:—

| Cables. | Interrupted. | Repaired. |
|---|---|---|
| Trinidad-Demerara (No. 1) | Aug. 26, 1901 | |
| Dominica-Martinique | May 7, 1903 | |
| St. Lucia-Martinique | May 7, 1903 | |
| Cayenne-Pinheiro | Aug. 13, 1903 | |
| Reissa-Issa (Yemen) Camaran | Oct. 22, 1902 | |
| Tarifa-Tangier | Jan. 18, 1904 | |
| Closed { Vladivostok-Nagasaki | Feb. 9, 1904 | |
| Closed { Port Arthur-Chifu | Mar. 9, 1304 | |
| Jamaica-Colon | Jan. 5, 1905 | |
| Martinique-Paramaribo | April 2, 1905 | |
| Medan-Olehleh | April 8, 1905 | |
| Pernambuco-Para | April 6, 1905 | |
| Maranham-Ceara | April 6, 1905 | |
| **Landlines.** | | |
| Puerto-Barrios | July 28, 1902 | |
| Kertch-Soutehoum | Sept. 27, 1904 | |
| Bhamo route beyond Tali | Jan. 15, 1905 | |
| Newfoundland—all places in the interior | Feb. 10, 1905 | |

**Wireless Telegraphy in Germany.**—It is officially announced that telegrams will be accepted between the German Imperial telegraph network, by the intermediary of coast stations fitted with wireless telegraphic apparatus, and ships which are equipped with similar installations. The authorities have issued regulations governing the exchange of messages, and give the follow-

ing list of coast stations where public communication is unrestricted:—Rishoeft, Arcona, Marienleuchie, Buelk, Heligoland, Cuxhaven, Borkum lighthouse and Borkumriff lightship. These stations have an uninterrupted day and night service. The naval authorities have ordered wireless telegraphic apparatus for seven warships from the Berlin Co. for Wireless Telegraphy on the "telefunken" system, while the military authorities propose to equip a number of fortifications with similar apparatus.

**Wireless Telegraphy.**—Mr. Yerburgh has asked the Secretary to the Admiralty whether in view of the importance of wireless telegraphy on the coasts of the United Kingdom in relation to national defence, any steps are being taken by the Admiralty to secure the control of all wireless telegraphic stations. Mr. Pretyman, replying in the Parliamentary papers, states that the matter has been, and is, occupying the interest and earnest attention of the Admiralty.

The *Elektrotechnischer-Anzeiger* states that the Turkish Government has recently signed a contract with Messrs. Siemens-Halske, of Berlin, for the construction of two radiotelegraphic stations. These two posts are to be established at Rhodes and at Derna. If communication between these two places mentioned, distant 700 kilometres from one another, gives good results, a number of other wireless telegraph stations will be established, especially in the Red Sea.

## CONTRACTS OPEN AND CLOSED.

### OPEN.

**Aberdeen.**—April 19th. Surface condenser, &c. See "Official Notices" March 24th.

**Africa.**—May 15th. The General Government of French West Africa at Dakar, is inviting tenders until May 15th, for the establishment of a central electric lighting and power station at Dakar.

**Batley.**—April 17th. Tramway reconstruction, permanent way, overhead equipment, cables, conduits, &c. See "Official Notices" March 24th.

**Bolton.**—April 27th. Stores for the electricity department. See "Official Notices" to-day.

**Bournemouth.**—April 20th. Steel poles, overhead line, section boxes, &c., for the tramways. See "Official Notices" April 7th.

**Bournemouth.**—April 29th. Feeder cables, troughing, excavation, &c., for the Christchurch tramways extension; also 11 electric cars. See "Official Notices" to-day.

**Cardiff.**—April 17th. Extra high-tension three-phase main switchboard, sub-station switchboards, motor-generators, rotary converters &c. See "Official Notices" April 7th.

**Devonport.**—April 18th. Surface condenser with electrically-driven pumps. See "Official Notices" April 7th.

**Dewsbury.**—April 17th. Tenders are being invited for the relaying and electrical equipment of the steam tramway system between Dewsbury and Gomersal:—(1) Permanent way construction and paving; (2) overhead equipment, steel poles &c.; (3) feeder cables, conduits and accessories.

**Dublin.**—May 15th. The Dublin Port and Docks Board is prepared to receive tenders for an electric generating station. Apply to Mr. John P. Griffith, M.Inst.C.E., East Wall, Dublin, for specifications &c., (deposit £5).

**Dublin.**—The Lighting Committee is prepared to consider proposals for the supply of motors to consumers, on the hire-purchase system. Secretary, Lighting Committee, 3, Cork Hill, Dublin.

**Edinburgh.**—May 8th. Water-tube boilers for the electricity works. See "Official Notices" to-day.

**France.**—May 14th. Tenders are being invited until May 14th, by the municipal authorities of Dax (Landes) for the concession for the electric lighting of the town during a period of 35 years. Tenders are to be sent to La Mairie de Dax (Landes), whence particulars can be obtained.

**France.**—May 15th. The Governor General of French West Africa, at Dakar (Senegal), is inviting tenders for the establishment of a central electricity station in the town, and for the construction of an electric tramway.

**Fulham.**—April 26th. Condenser piping; steel roof and bunker work; coal conveying apparatus for the Electricity Department. See "Official Notices" to-day.

**Glasgow.**—April 17th. Main cables, meters and carbons for the Electricity Department for one year. See "Official Notices" April 7th.

**Govan.**—April 25th. Stores for the electricity department. See "Official Notices" to-day.

**Hull.**—April 17th. Air-spaced telephone cable for the Council. See "Official Notices" April 7th.

**Johannesburg.**—April 27th. Switchboards and accessories for the new direct and alternating current power station. See "Official Notices" March 31st.

**Johannesburg.**—May 7th. Tramway poles, feeder pillars, overhead material, telescopic ladders, motor tower wagon, &c. See "Official Notices" March 17th.

**Lower Bebington.**—April 24th. The U.D.C. invites tenders for the electric installation for Fire Brigade Alarm in New Ferry. Surveyor, Public Offices.

**Penang.**—April 18th. A 300-KW. steam dynamo, motor generator, balancer, switchboards &c., for the Municipal Council. See "Official Notices" March 31st.

**Portsmouth.**—May 1st. Tramway stores for the Corporation. See "Official Notices" to-day.

**Stockport.**—April 26th. One 500-KW. steam-driven generator. See "Official Notices" April 7th.

**Swindon.**—April 17th. Electric motors for three years. See "Official Notices" April 7th.

**Wallasey.**—April 27th. Stores for the electricity department. See "Official Notices" to-day.

**Wimbledon.**—April 28th. 1,000-KW. steam-driven turbo-alternator with condensing plant, switchgear and pipework. See "Official Notices" April 7th.

### CLOSED.

**Aldershot.**—The U.D.C. has accepted the tender of Messrs. Pritchetts & Gold, for the erection of new batteries (£405 10s.) for the electric lighting station.

**Battersea.**—The B.C. has placed an order with Messrs. Parsons & Co., for a spare armature, at £573.

**Bradford.**—The Corporation Electricity Committee has accepted the tender of the British Westinghouse Electric and Manufacturing Co., Ltd., for the supply of generators, in connection with the introduction of the three-phase system.

**Bolton.**—The Tramways Committee has accepted tenders for stores for the ensuing year from the General Electric Co., the Incandescent Lamp Co., the Bolton Corporation Fittings Department, Messrs. Blackwell & Co., and the Electric Tramways Equipment Co.

**Bury (Lancs.).**—The T.C. has accepted the tender of Messrs. Chas. Walmsley & Co., Ltd., of Elton, for the supply of a condenser at the E.L. works.

**Colchester.**—The T.C. has accepted the tender of the Harris Patent Feed Water Filter, Ltd., for a patent filter at the E.L. Works, at £440, with £78 for connecting up with the present system.

**Derby.**—Last week the T.C. adopted the recommendation of the Tramways Committee to accept the tender of Messrs. W. Griffiths & Co., Ltd., amounting to £18,689, for the extension of the tramways from the Market Place to the borough boundary on the Kedleston Road, and for the construction of a loop to connect the Dairy House Road and Cavendish Hotel termini. They further recommended the acceptance of the tender of the Brush Electrical Engineering Co., Ltd., amounting to £2,504, for the supply of four electric tramcars. There were 17 tenders for the proposed extensions, of which the highest was £35,201, and the lowest £18,629, being a difference of £16,512. There were nine tenders for the cars, which would be covered and fitted with the latest improvements.

**Fulham.**—The B.C has accepted the following tenders for engineers' stores for the Electricity Undertaking:—

Asbestos goods, Messrs. W. H. Wilcox & Co., Ltd.
Rubber goods and street lighting, Messrs. J. Gibb & Co., Ltd.
Carbons, General Electric Co., Ltd.
Service boxes, British Insulated & Helsby Cables Co., Ltd.

| | Coal. | Price per ton. Road. | Barge. |
|---|---|---|---|
| | | s. d. | s. d. |
| W. Cory & Son, Ltd. (accepted at 10s.) .. | Broomhill rough small .. | 14 0 | 10 0 |
| | Hartley rough .. .. .. | 12 9 | 8 9 |
| Newcombe, Harris and Hardman, Ltd. .. | Maude rough small .. .. | — | 10 6 |
| J. Hudson & Co., Ltd. | Manners' rough small .. | 13 0 | 11 0 |
| | Scotch rough small .. .. | 13 0 | 9 9 |
| Gardner, Lockett and Hinton .. .. .. | North of England rough small and Scotch shingles .. | — | 12 6 |
| Thomas & Co. .. .. | Birchgrave Graigola or Dyllas best Welsh smokeless .. | 14 9 | nearest railway station. |
| Charrington, Sells, Dale and Co. .. .. .. | Albert nuts (Yorkshire) .. | 14 0 | 12 0 |

**Fulham.**—The Council has received the following tenders:—

CONDENSING PLANT.

| | 28 in. vacuum. | 26 in. vacuum. |
|---|---|---|
| Schwarz & Co. | £2,145 0 | — |
| Balcke & Co. | 1,948 19 | — |
| Ashwell & Nesbit | 1,940 15 | £1,880 15 |
| Summers & Scott | 1,720 0 | 1,490 0 |
| Thornton & Co. | 1,709 0 | 1,625 0 |
| Wheeler Condenser Co. | 1,681 0 | 1,395 0 |
| Storey & Sons | 1,655 15 | 1,390 12 |
| Cole, Marchent & Morley | 1,579 10 | 1,214 10 |
| Belliss & Morcom | 1,472 0 | 1,392 0 |
| Carrick Wardale | 1,544 0 | — |
| Bertrams, Ltd. | 1,505 0 | 1,251 10 |
| Scott & Co. | 1,481 0 | 1,256 0 |
| Musgrave & Co. | 1,481 0 | — |
| Mirlees-Watson Co., Ltd. | 1,475 0 | 1,145 0 |
| Masson & Scott | 1,470 0 | 1,205 0 |
| Bailey & Co., Ltd. | — | 1,450 0 |
| Richardsons, Westgarth & Co., Ltd. | 1,436 0 | 1,185 0 |
| Coombe, Barbour & Co., Ltd. | 1,405 0 | 1,355 0 |
| Mather & Platt | 1,388 0 | — |
| Worthington Pump Co., Ltd. | 1,383 0 | * 1,119 10 |
| W. H. Allen, Son & Co., Ltd. | — | 1,192 0 |

* Accepted.

ECONOMISERS.

| | |
|---|---|
| Goodbrand & Co., Ltd. | £2,751 10 |
| Clay Cross Co., Ltd. | 2,665 0 |
| Lowcock & Co., Ltd. | 2,665 0 |
| H. Windsor & Co., Ltd. | 2,650 0 |
| Green & Son | (accepted) 2,640 0 |
| Danks & Co., Ltd. | 2,640 0 |
| Stirling Boiler Co., Ltd. | 2,158 0 |
| Carter & Sons | 2,105 0 |

STOKERS.

| | |
|---|---|
| Erith Engineering Co., Ltd. | £1,669 0 |
| Rowlands & Co., Ltd. | 1,221 0 |
| Danks & Co., Ltd. | 1,190 0 |
| Underfeed Stoker Co., Ltd. | 1,083 0 |
| " " " (alternative)—(accepted) | 875 0 |

**Leicester.**—The T.C. has accepted the tender of Messrs. W. T. Glover & Co., Ltd., of Manchester, for the supply of cable and troughing for the Nottingham Road extension.

**Leith.**—Messrs. Ferranti, Ltd., have received an order from the Corporation for a traction switchboard.

Messrs. S. Dixon & Son, Ltd., Leeds, have secured the contract for the supply of the whole of the overhead fittings to be used in connection with the new tramway system at Leith, which is to be on the grooved wire principle. The same firm will supply the feeder pillars.

**Liverpool.**—The tender of the Electrical Co., Ltd., for the supply and erection of arc lamps, posts, cables, &c., required for lighting the entrance to Sandon Dock, the North and South passages to Huskisson Dock, and the Huskisson Dock and Branches, has been accepted by the Mersey Docks and Harbour Board.

**Manchester.**—The annual contract for the supply of overhead line fittings, for the Manchester Corporation Tramways, has been placed with Messrs. S. Dixon & Son, Ltd., Leeds.

**Marylebone.**—The Electric Supply Committee has received the following tenders for the supply, erection and connecting-up of 880 yds. of 2 sq. in. and 440 yds. of 1 sq. in. fire-resisting cables:—

| | | |
|---|---|---|
| St. Helens Cable Co., Ltd. | (provisionally accepted) | £1,381 0 |
| W. T. Glover & Co., Ltd. | | 1,722 0 |
| British Insulated & Helsby Cables, Ltd. | | 1,732 10 |
| Siemens Bros. & Co., Ltd. | | 1,779 12 |
| W. T. Henley's Telegraph Works Co., Ltd. | | 1,901 0 |

For the supply of cards and cabinets required for working the several sections of the Department on the card system:—

| | | |
|---|---|---|
| The Shannon, Ltd. | (provisionally accepted) | £189 10 |
| The Library Bureau, Ltd. | | 208 10 |
| The Library Supply Co. | | 217 16 |

**Newport (Mon.).**—The Electricity and Tramways Committee has accepted a number of tenders for the supply of stores for the Electricity and Tramways Departments.

The Guardians have given the contract for electric light fittings for the next 12 months to Messrs. A. G. Arnold & Son, a local firm.

The Corporation has accepted the following tenders for additional plant at the power station, Corporation Road:—

Browett, Lindley & Co., Ltd., 1,300-KW. steam engine generator, 1,200-KW. steam balancer, including two generators, to be supplied by General Electric Co., £2,984.
Babcock & Wilcox, boiler, £950.
R. Alger & Son, switchboard, £405.
W. A. Baker & Co., Ltd., switchboard gallery, £145.

**Pontypridd.**—The tender of the Electrical Co., Ltd., for the electrification of the Penhriw Colliery, and the supply of high-tension transmission lines, sub-station equipment, switchboards, power and lighting transformers, motors for electric haulages and dip pumps, motor-generator and motor-driven high lift centrifugal pump, has been accepted by the Board of the Great Western Collieries.

**Stalybridge.**—The Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board has accepted the tender of the British Westinghouse Electric & Manufacturing Co., Ltd., for the supply of five tramcars.

**Port Elizabeth.**—The following is a list of the tenders accepted by Mr. R. Pape, the city electrical engineer, during his recent stay in this country:—

| | |
|---|---|
| Vertical water-tube boilers | Messrs. Tinkers. |
| Turbines, dynamos and accessories | Brush Electrical Engineering Co. |
| Cables | Western Electric Co. |
| Battery | E.P.S. Co. |
| Switchboard | Spagnoletti & Co. |
| Overhead crane | Spencer & Co. |
| Arc and Nernst lamps and pillars | General Electric Co. |
| Meters | Reason Manufacturing Co. |
| Tools | Geo. Hatch & Co. |

The total amount is £45,000. In every section the work was open to tender, and the best tenders were received from home manufacturers.

**Portsmouth.**—The Tramway Committee submitted the following tenders for 200 steel tires, and on their recommendation the first-named was accepted:—

The Steel Peech & Tozar Co., £1 9s. each.
Mr. John Brown, £1 9s. 6d.
Cammell, Laird & Co., £1 10s.
Messrs. Hadfield's, £1 15s.

The following tenders were received by the Telephone Committee for an extension of the telephone switchboard:—

The International Electric Co. (1) £1,327 10s.; (2) £1,835.
The Ericsson Bell Co. (1) £1,475; (2) £1,980.
British Insulated & Helsby Cables, Ltd. (1) £1,640; (2) £2,340.

The T.C. endorsed the recommendation of the Committee that, subject to the tender of the International Electric Co. being found, after examination by Mr. Bennett, to comply with the specification, it be accepted, and that it be left to the Committee to decide which of two alternative extensions shall be carried out. The specification provides (1) for an extension of 320 positions, and (2) for an alternative extension of 640 positions.

**Salford.**—The Corporation has awarded Messrs. R. J. Nicholson & Co., of Manchester, the contract for the electric lighting of the Seedley Schools, together with the supply of the necessary fittings.

The T.C. on April 5th accepted the following tenders in connection with the Electricity and Tramway undertakings:—

F. Smith & Co., Salford, six drums of copper trolley wire (1,050 yds. each), at 9d. lb.
W. T. Glover & Co., Ltd., cable for Ship Canal Docks Electricity Supply, £1,948.
Johnson & Phillips, Ltd., rubber insulated fire resisting cable, £265 10s.
Tudor Accumulator Co., Ltd., repairs and renewals of two storage batteries, £820.
Howard Conduit Co., Ltd., asphalt troughing.
British Insulated & Helsby Cables, Ltd., house fuse boxes.
Doulton & Co., Ltd., earthware pipes and conduits.
General Electric Co., Ltd., carbons for arc lamp and screwed tubing.
Rowland Carr & Co., best Trinidad bitumen, 5s. 2d. cwt.
Simplified Underground Conductor Co., Ltd., asphaltic concrete, £2 1s. 9d. per ton.
Reason Manufacturing Co., Ltd., Ferranti, Ltd., and Chamberlain & Hookham, Ltd., meters.
General Electric Co., Ltd., Royce, Ltd., and Lancashire Dynamo & Motor Co., Ltd., motors.
Messrs. Grant & Aldcroft, creosoted wood troughing.

**South Shields.**—The Tramways and Electrical Committees of the T.C. has accepted the following tenders:—

Wm. Underwood & Bros, construction of permanent way and track, £42,909, also copper rail bonds and bonding of tramways, £770.
Dick, Kerr & Co., Ltd., generators, £2,695.
J. & H. McLaren, Leeds, engines, £8,400.

**Swindon.**—The T.C. has accepted the following tenders:—

W. & T. Avery, Ltd., Birmingham, 10-ton weighbridge (Electricity Works) £70.
Bennis Stoker Co., Ltd., Bolton, mechanical stoker, £127 10s.
Siemens Bros., re-winding armatures of motor-generator, £46 each.

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**Erratum.**—A printer's error occurred in our leading article last week, the item for repairs, renewals, &c., being entered twice; the first 1·86d. should be deleted. The total is correct, and the error does not affect the subsequent working.

**Muchee Muchee Sad.**—Two Chinamen, employed on the East Rand Proprietary Mines, noticed the ends of a copper wire hanging from the electric light lines. They tried to cut a piece off, but as the wires were "alive" they were electrocuted.

**Railway Companies and Motor-Omnibuses.**—We read in the *Times* that the adjourned meeting of the Manchester Tramways Conference, held at the Westminster Palace Hotel on Saturday, discussed the proposed institution of motor-omnibus service by railway companies. It was reported that the Midland and the Great Western Companies had withdrawn the omnibus clauses; and that the North-Eastern Railway Co. were prepared to make some concessions in order to meet the views of municipal and other tramway owners. Sir Edward Grey, M.P., as a director of the North-Eastern Co., intimated that, whilst they would try to meet the objections of tramway owners in urban districts, they desired full liberty for giving motor-omnibus facilities in country districts. The meeting was adjourned to consider what amendments the North-Eastern Co. are willing to make in their motor-omnibus clause.

## FORTHCOMING EVENTS.

**To-day's Arrangements.**—At 7.30 p.m. North East Coast Institution of Engineers and Shipbuilders. "The Influence of Oil on the Ultimate Strength of Boiler Furnaces," by Mr. D. B. Morison.
At 8 p.m. Physical Society. "The Determination of the Moment of Inertia of the Magnets used in the Measurement of the Horizontal Component of the Earth's Field," and "Exhibition of a Series of Lecture Experiments, illustrating the Properties of the Gaseous Ions produced by Radium and other Sources," by Dr. W. Watson.
At 8 p.m. I.M.E. Presidential Address by Mr. Edward P. Martin. "Steam Engine Research Report" discussion will be concluded, and Prof Capper will reply.
At 9 p.m. Royal Institution. "The Law of Pressure of Gases below Atmosphere," by Lord Rayleigh.

Saturday, April 15th.—At 10.15 a.m. (At gates of works.) I.E.E. (Manchester Students). Visit to the Peel Works, Salford, of the General Electric Co., Ltd.
Tuesday, April 18th.—At 8 p.m. Institution of Civil Engineers. Annual General Meeting.
Wednesday, April 19th.—At 7 p.m. The Manchester and North of England Horological Society Meeting at the Municipal School of Technology. "Electric Clocks," by Mr. F. Hope-Jones. Members of the Manchester Section of the I.E.E. are invited.
At 5.30 p.m. Chemical Society Meeting.

## THE ELECTRICAL ENGINEERS R.E. (VOLS.).

**The following orders are issued for next week:—**

There will be no Technical Instruction at Headquarters during the week.
Monday, April 17.—"A" Company. Hopkinson Cup Competition, 7 p.m.
Tuesday, April 18.—"B" Company. Hopkinson Cup Competition, 7 p.m. Medical Inspection for Recruits and Special Service Section, 7 p.m.
Wednesday, April 19.—"D" Company. Hopkinson Cup Competition, 7 p.m.
Thursday, April 20.—"C" Company. Hopkinson Cup Competition, 7 p.m. Recruits and non-efficients for Easter Camp at Weymouth, parade at Waterloo Station, L. & S.W. Railway, at 12 noon.
Friday, April 21.—Headquarters closed.
Saturday, April 22.—Efficients for Easter Camp at Weymouth, parade at Waterloo Station, L. & S.W. Railway, at 12 noon.
Headquarters will be closed from Thursday night until Tuesday morning, 25th inst.

H. T. O'Shaughnessy, Captain R.E.
For O.C.E.E.R.E. (V.)

## NOTES.

**Next Week's "Electrical Review."**—Next Friday being Good Friday, the Electrical Review, due to appear on that day, will be published two days earlier, *i.e.*, Wednesday morning, April 19th. All matter intended for our "Correspondence" and article columns should reach us by first post on Monday morning, April 17th. Other news and notes should reach us some time during Monday, or at latest by first post on Tuesday.

Our Advertisement Department announces that new copy and alterations to existing displayed advertisements should be received not later than to-morrow, Saturday morning (15th inst.).

Official Notices and small prepaid advertisements can be received up to the morning of Tuesday, 18th inst.

**Charging for Power Energy.**—We have received from Mr. H. Richardson, city electrical and tramways engineer to the Dundee Corporation, particulars of a new system of charging for electrical energy supplied for motive power, which he is recommending for adoption. In a report to the Tramways Committee, dated 27th ult., Mr. Richardson points out that power stations should be built primarily for the supply of power, and only secondarily for lighting purposes—a view with which we are, and have long been, in cordial agreement. Whether this course is yet practicable or not does not affect the question of what *ought* to be done.

Mr. Richardson has apparently tackled the subject without taking much notice of what has been already accomplished, as he makes no reference to the exhaustive treatment of the question in various I.E.E. papers. The main feature of novelty in his proposals consists in the suggestion that the proportion of standing charges allotted to a consumer with a small maximum demand should be greater than in the case of one whose maximum demand is greater.

In order to carry out this principle, without, however, alarming the consumer by a complicated system of calculation, Mr. Richardson has embodied the tariff resulting from his investigations in the shape of a set of tables, so that a consumer, knowing his maximum demand and his total consumption of energy, can at once ascertain the rate per unit at which he must pay. In this we think Mr. Richardson is well advised; probably the maximum demand system would have succeeded far more generally than it has if this course had been followed in every instance. As a matter of fact, of course, it is well known that the M.D. system is dying out, owing mainly to the difficulty of explaining it to consumers.

Mr. Richardson explains why it is that power consumers whose load factor is high are much more profitable customers than even tramways. We need not go into the details of his calculations; suffice it to say, that he makes the standing charges per annum in £ per KW. ($a$) vary according to the formula—

$$a = 5 + \frac{1}{b+1},$$

where $b$ is the maximum demand in KW. It will be seen, therefore, that $a$ varies from a maximum value of £5 10s. for a small consumer to a minimum of £5 for the largest. Given that the running costs per unit (including profit) are ·71d in Dundee, if $c$ = the total units consumed per quarter, the price per unit all round will obviously be—

$$\frac{60 \times a\ b}{c} + \cdot 71, \text{ in pence.}$$

We may point out that practically the same result would be attained by charging on the ordinary maximum demand system at prices ranging between 4d. and 4½d. per unit for the first hour's use of the maximum demand, and ·71d. per unit for all afterwards; the initial price being varied according to the magnitude of the consumer's maximum demand.

On the whole, we fail to see that Mr. Richardson's system exhibits any material improvement over existing systems. To our mind, the whole thing is faulty, for a motor user's maximum demand may occur at any time of the day whatever, and unless it happens to occur at the same time as the peak load, it has no effect at all on the quantity of plant installed. When the lighting load was practically the whole load, the maximum demand system could be applied with justice; but nowadays the conditions are altered, and the only system which approximately fits them is, in our opinion, the two-rate meter system.

**Third Rails and Trespassers.**—The report is issued of Lieut.-Colonel Von Donop to the Board of Trade on the death of the girl, Elizabeth Chapman, who was killed by coming into contact with the "live" rail on the North-Eastern Electric Railway, near Monkseaton, on February 20th, as reported by us at the time. It will be remembered that the girl crossed the line at the point where the "live" rail was not protected, although there were two crossings close by where the rail was guarded, and in order to save a few yards the girl did not use the crossings that were protected. In the circumstances Colonel Von Donop considers that further guards of the live rail were not called for.

At Birkdale, where the traffic is pressing, the Lancashire and Yorkshire Railway Co. have placed an effective wire guard, which is unclimbable, for a considerable distance in the direction of Liverpool, and they have successfully concluded negotiations with the Birkdale District Council for the widening of the level crossing at Birkdale over the electric railway from 28 ft. to 36 ft. At Freshfield, on the same line, a footbridge has been erected, and one is in contemplation for Ainsdale, so that the public are being safeguarded at all points. It seems that nothing but a deliberate act of trespass can now endanger the passenger, while, with regard to the service generally, the new electric trains are running to time, and the speed and punctuality on the electrified line are greatly appreciated.

At the Southport Police court on Monday the magistrates had before them Luke Howard (Hart Street), Ernest Walmsley (Kensington Road), and James Riding (Newton Street), for trespassing on the Lancashire and Yorkshire Electric Railway. Defendants pleaded guilty. Mr. Daniel, solicitor for the company, stated that on the 1st inst. the defendants crossed the post and rail fence between Southport and Crossens, and crossed the electric line to Chadwick's Field. There was very great danger from the public crossing the line on account of the exposed "live" rail. By the defendants' example other people were doing the same thing, and on Saturday the company's officer had seen children crossing the line. Notices were posted as required by the company's Act, and defendants were liable to a penalty of 40s. The Chairman (Mr. T. O. Chinning) pointed out the danger of crossing the electric line, and said the Bench would not deal as leniently with future cases. Each defendant was fined 5s. and costs.

**Tube Railway Fatality.**—On Monday last week a porter employed at the Great Northern and City Railway Station at Highbury, met his death while at work on the metals. As a train approached from Moorgate he ran along the side of the line with his pail, and stopping leaned with his back against the concave wall. After the train had passed he was found in a doubled-up position dead. The medical evidence showed that there was no indication of electric action, death being due to extensive fracture of the base of the skull. There was stated to be 2 ft. 6 in. clear space between the metals and the wall, and the station-master said he considered 1 ft. 11 in. with a concave wall behind a sufficient space in which to lean safely. He said that work was only done while the staff was present and traffic running, between 5.49 a.m. and 11.20 p.m., after which all the stations were closed. A juror suggested that such dangerous work should be done either before the traffic began or after it ceased.

The jury, in returning a verdict of accidental death, recommended that the directors should, if possible, devise and adopt means calculated to prevent similar mishaps in the future.

**Discriminating Relays and Cut-outs.**—We have received a letter from Mr. C. Dudding, of Cape Town, South Africa, consisting mainly of warm eulogy of Mr. Andrews, whose blushes we will spare, as the matter has no particular bearing upon the recent controversy. We may, however, extract the following as a useful contribution to the debate:—"In the years I have worked with Mr. Andrews's devices, both at Home and out here, on direct and alternating circuits, I have practically never know them to fail."

**Appeal Dismissed.**—The Court yesterday morning dismissed the appeal of the plaintiffs' in the case of the Patent Exploitation, Ltd., *v.* American Electrical Novelty, &c., Co., Ltd.

**Telephone Exchange Fire.**—On Tuesday Dr. F. J. Waldo resumed the inquiry into the causes of the fires at Mansion House Chambers and Oxford Court. According to the *Times*, Mr. C. B. Clay, metropolitan superintendent of the National Telephone Co., stated that the fire originated on the District Railway at Westminster Bridge Station. They had had some cables along the railway for many years. The cables had been taken from their position, and were to have been permanently placed along the front of the platform and covered in. This work had not been completed, and the metal cable cover appeared to have been left touching the cables and the "live" rail. When the current was turned on, it thus got to the telephone cables. The 500-volt current could not have got to the subscribers' instruments, because the wires would not bear the pressure. The Telephone Co. were not responsible. He had never heard of a case in which a telephone subscriber using his instrument was injured through a high-pressure current on the wire. Cross-examined, he admitted that other modern exchanges were better protected against high-pressure currents, but the protective heat coils were not put into exchanges likely to be removed. He had received shocks while using telephones. Mr. H. L. Dixon, inspector of overhead wires in the City of London, gave evidence as to the effect of shocks through telephones. Mr. W. E. Hanson, constructing engineer to the Underground Electric Railways Co. of London, Ltd., stated that he found a metal trough lying across the "live" rail where the telephone cables had been lying. He did not know how the metal trough got there. It would be the workmen's duty to clear the line. Mr. S. B. Fortenbaugh, electrical engineer, also gave evidence, and the inquiry was adjourned for a week.

**Fatality at Islington.**—The Islington Lighting Committee reported on Wednesday that on Friday, the 7th inst., at or about 10.50 p.m., Mr. B. M. Coxeter, senior shift engineer, was killed while carrying out his duties at the electric lighting station. "There were no actual witnesses to the accident, but Mr. Coxeter was found lying near one of the rectifiers, and it is presumed that he received a shock from the machine while making the customary adjustments. Every effort was made to restore consciousness to the deceased under the supervision of Dr. White, and artificial respiration was attempted for two hours, but without success."

The inquest was held on Tuesday afternoon. The evidence showed that Coxeter was found lying on the floor shaking violently. Artificial respiration was used, but deceased expired almost at once. He had hold of a key used for the rectifiers when found. Dr. Dace said that he found that the palm of the right hand was blistered, whilst there were also blisters on the chest and abdomen, caused by electricity.—Mr. Albert Gay, consulting and chief electrical engineer, said that the deceased, who was a most competent engineer, had been employed at the Eden Grove station for eight years, and he had great confidence in him. It was most difficult to explain what did happen, but he assumed that he was doing something to the brushes. Deceased would use a key for this work, and he having a blister in the palm of the hand, it might be that he did not grasp the handle of the key, which was insulated, and that a sudden slip of the hand brought it down to that portion which was alive. It was not possible to have the whole of the key covered, owing to the kind of operation that was necessary. It was possible that the deceased might have slipped, or that a temporary loss of memory caused him to make a mistake. Deceased was a most technical officer, therefore fully alive to the dangers of the work. The work that he was doing, he would perhaps do several times in a day. The current was from 1,500 to 2,000 volts. Unless he slipped, or his hand slipped down to the live portion of the key, to him the work would not be dangerous. It had not been their rule to use gloves at this particular work, because the handle of the key was insulated, but he now had to admit, after this accident, that, had gloves been used, the accident would not have occurred. He should, for protection in future, see that to prevent the hand slipping to the live portions, an ebonite disk was fitted to the handle which would be made larger so that it would be a kind of a shield. He examined the key afterwards and found that it was not broken.—By H.M. Inspector: The key that was used was one that had always been considered the proper key to use, and it was made specially for the purpose. It was not before thought necessary to use the gloves. Gloves were usual when high tension currents were used. The Coroner said he took it that Witness was of opinion that this was purely an accident. Mr. Gay said that was so. This work had been done thousands of times without an accident. The Coroner said it seemed that there was no doubt the accident took place when deceased was attending to the brushes of the rectifier, owing to his hand slipping. This was the first death from an electric shock that they had had at the works. The whole staff were insured. The Coroner supposed that this was a case that came under the Workmen's Compensation Act. Mr. Bramell said there was a difficulty, for deceased was not a workman. Mr. Lithgow was of opinion that the case was clearly one that came within the Workmen's Compensation Act. The jury returned a verdict of "Accidental Death."

**Institution and Lecture Notes.**—On 8th inst. Mr. W. H. Whitehouse, M.I.E.E., read a paper before the members of the Birmingham and District Electric Club on "Lightning Conductors." The author referred to Sir W. Preece's statement before the Institution of Electrical Engineers in 1889, that in 1872 19 per cent. of the telegraph instruments were damaged by lightning. In the year 1889 the number damaged was only 1·3 per cent., this result being due to the employment of an ordinary galvanised No. 4 iron wire down each pole. The lecturer then proceeded to describe the phenomenon of the lightning discharge, forked, sheet, globular, and St. Elmos fire, thunder, &c. The work of Franklin at Philadelphia, and M. Dalibard at Marly-la-Villa, was mentioned in proving the identity of lightning with ordinary frictional or static electricity as shown by the action of the Leyden jars, electroscopes, &c. Mr. Whitehouse referred to the difference of opinion as to the relative merits of points or knobs on the top of a conductor, which gave rise to such heated discussion in the reign of George III. During the past 20 years, owing to increased knowledge of electrical science, the theory of lightning has been entirely changed. The discharge being alternating, of high frequency (and not, as formerly supposed, direct), the laws of ohmic resistance do not apply, hence the superiority of copper over iron no longer exists. Attention was then drawn to the papers read by Sir Oliver Lodge. The lecturer in concluding gave a summary of what he deemed (in our present knowledge of the subject) to be the essentials of a proper system of lightning conductors. Through the kindness of Mr. A. Hands (G. W. Grey & Sons, Leadenhall Street, London,) the paper was illustrated by a number of photo slides of churches and buildings damaged by lightning.

On Saturday the members of the Huddersfield Branch of the National Engineering Society listened to a lecture by Mr. Arthur Hollingworth, of the Corporation electric department, on "Telephones, Past and Present."

At a meeting of the Newcastle Association of Students of the Institution of Civil Engineers, Mr. Wilfrid Hill delivered a lecture on "The Electrical Equipment of Workshops and Shipyards." Mr. Gerald Stoney presided.

The following are among the lecture arrangements at the Royal Institution after Easter:—Prof. Sir James Dewar, three lectures on "Flame"; Prof. J. A. Fleming, three lectures on "Electromagnetic Waves" (the Tyndall lectures).

Last Friday, at the Royal Institution, a lecture was delivered by Mr. Alfred Mosely, C.M.G., on "American Industry."

A large number of members of the Junior Institution of Engineers visited the Willesden power house of the North Metropolitan Electric Power Supply Co. at Taylor's Lane on Thursday evening, April 6th. In the unavoidable absence of the engineer, Mr. E. T. Ruthven Murray, they were conducted round by the station superintendent, Mr. F. D. Napier, and his assistants. The Vice-Chairman of the Institution, Mr. Adam Hunter, at the conclusion of the visit, expressed the acknowledgements of the members for the arrangements that had been made for their reception.

At the Royal Society meeting held yesterday afternoon, the following papers were read:—By Dr. J. A. Harker "On a New Type of Electric Furnace; with a Re-determination of the Melting-point of Platinum," communicated by Dr. R. T. Glazebrook, F.R.S.; and by Dr. P. E. Shaw, "The Improved Electric Micrometer," communicated by Prof. J. H Poynting, F.R.S

**Appointments Vacant.**—Mains superintendent for Bermondsey (£170); assistant foreman for overhead line work at Blackburn (30s); shift engineer (35s.), and two switchboard attendants (25s.), for Finchley; jointer for Elland; lecturer on electrical engineering (£160) for Hull Municipal Technical School; additional assistants are wanted for the Electrical Engineering Department at the City and Guilds College, Exhibition Road.

## OUR PERSONAL COLUMN.

[*The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* Electrical Review *posted as to their movements.*]

**Central Station Engineers.**—The staff at the Portsmouth tramway power station, on Friday, presented a marble clock to Mr. W. J. Vincent, shift engineer, on his marriage.

The Ossett T.C. has appointed Mr. Walter Emmott, of Halifax, as engineer of the electricity undertaking which is about to be carried out.

Mr. Box, electrical engineer at Kroonstad, recently tendered his resignation to the T.C., and it was accepted.

The Carlisle Electricity Committee has increased the salary of Mr. G. G. Sourfield, deputy electrical engineer, from £150 to £175 per annum.

Mr. R. Pape, of Port Elizabeth, left England for South Africa by R.M.S. *Saxon* on April 1st. During his stay in this country he arranged contracts to the tune of £45,000, all being placed with British manufacturers. Some particulars of these contracts appear in "Contracts Closed," to-day. Mr. Pape hopes to have his station in working order by Christmas.

**Tramway Officials.**—The Southampton Tramways Committee has recommended the appointment of Mr. H. E. Yerbury, chief electrical engineer and deputy manager of the tramways at Sheffield, as tramway manager at an annual salary of £500, rising by £25 a year to £600. A section of the committee is in favour of the appointment being given to the Southampton electrical engineer as a dual office.

The King's Norton U.D.C. has decided to grant £350 to Mr. A. W. Cross for special and extra services rendered in connection with the electric tramway undertaking.

The Liverpool T.C., on April 5th, granted the following increases of salary:—Mr. Chas. W. Mallins, tramway traffic superintendent, from £400 to £500 per annum; Mr. C. R. Bellamy, general manager of the tramways, from £1,200 to £1,400 per annum; and Mr. A. Clough, resident electrical engineer, from £800 to £900 a year.

On the recommendation of the Tramways Committee, the Portsmouth T.C. has decided that the salary of Mr. V. G. Liboni, the resident engineer at the power station, be increased from £250 to £300 per annum forthwith, and then to £400 per annum by four annual instalments of £25 each. The salary of the traffic superintendent, Mr. W. Mumford, is to be increased from £156 to £165 per annum, and then to £175 by two annual instalments of £5 each.

The circumstances under which Mr. James Dalrymple, general manager of the Glasgow Corporation Tramways (reported in last week's Review), has gone to Chicago are somewhat unique. On Thursday morning last week, the Lord Provost of the city received a cablegram as follows:—"Chicago, the first great city in America, following the lead of Glasgow, declares for municipalisation of street cars by 25 000 majority. Will you give the manager of your municipal tramways a vacation of 30 days to visit Chicago to confer with me? All expenses, first-class travelling and hotel bills will be paid by me. Answer.—Edward F. Dunn." A meeting of the Tramways Committee of the T.C. was called, and in the afternoon the Corporation granted Mr. Dalrymple the desired leave of absence.

**General.**—The third annual dinner of the Northampton Institute day students was held at Anderton's Hotel, Fleet Street, on Thursday, April 6th. The chair was occupied by Mr. G. Van Vestraut, and among others of the staff present were Dr. R. Mullineux Walmsley, Dr. C. V. Drysdale, and Mr. C. E. Larard. A good musical programme was rendered by the students and staff.

The first award of the John Fritz Medal, which was established by the professional associates and friends of John Fritz, of Bethlehem, Pennsylvania, U.S.A., on August 21st 1902, his eightieth birthday, to perpetuate the memory of his achievements in industrial progress, has been awarded to Lord Kelvin. This award was made by a board selected for the purpose from the membership of the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, and the members of the American Institute of Electrical Engineers. The medal is of gold, of the value of about $100, and with it is presented a certificate of the award. The medal was awarded to Lord Kelvin for "Cable Telegraphy and other General Scientific Achievements."

It is announced that Lord Kelvin's condition continues to improve. It is expected that he will be able to leave his bed in about a fortnight's time.

On April 9th, in Vienna, Mr. Alfred Jaray, a director of Frank Suter & Co., Ltd., was married to Miss Fanny Hirsch.

*Science* says that Prof. L. C. Herdt, assistant professor of electrical engineering at McGill University, has been awarded the honorary title of Officier d'Académie by the French Government.

The transfer of the business of the British Schuckert Electric Co., Ltd., to Messrs. Siemens Bros. & Co., Ltd., London, being now complete, Mr. Arthur Jacob, M.I.E.E., late general manager, has entered the service of the latter company. Further communications should be addressed York Mansions, York Street, Westminster, London, S.W.

Mr. F. A. Glover, managing director of F. A. Glover & Co., Ltd., is to be married on Thursday, 20th inst. As the whole staff and employés are to have a holiday on that day, the offices and works will be closed.

Mr. J. Bertram Gibbons, A.M.I.E.E., representative of the Oriental Telephone and Electric Co., arrived in Colombo on March 14th on his way to Singapore. He is taking charge of the reconstruction of the telephone system in the Straits, where the cables have to be laid anew underground.

**Obituary.**—Edwin Thomas Truman.—By the death of Mr. E. T. Truman, at the advanced age of 86, a remarkable character has been removed from the world. Probably, however, very few of the electrical profession were aware of even the existence of such a personality; much less, indeed, of the services which he rendered to the cause of submarine telegraphy. It is, perhaps, not too much to say, that no person had such an intimate knowledge of the properties of gutta-percha, or, in the early days of the introduction of that material, did so much to make its remarkable qualities of such value to dentistry and electrical science as Mr. Truman. In a somewhat casual way, many years ago, the services which he had rendered in making the use of gutta-percha possible for the insulation of the cores of submarine cables were mentioned at a public dinner, and subsequently a long letter appeared in the *Times* pointing out Mr. Truman's great services in regard to the use of the material. A skilful mechanician, Mr. Truman for many years continued experimenting and designing machinery for perfecting the system of covering copper wires with gutta-percha, and for obtaining the latter in a highly purified state; he also aimed at reducing the specific inductive capacity of the material, with considerable success. It may be questioned, however, whether his processes did not err on the side of unnecessary refinement, which considerably discounted their practical value. Of a reserved, if not of a suspicious, nature in regard to his dealings with commercial men, he hesitated to place his really valuable work at the disposal of those who could have advanced his interests, with the result that the work was practically lost to the world. Mr. Truman was the author of a number of patents of considerable value. Had not the introduction of paper insulation practically sealed the fate of gutta-percha as a material for covering underground wires, it is probable that more might have been heard and known of Mr. Truman's work, especially in regard to his processes for the preservation of the material by means of black lead.

We regret having to record the death of Mr. John Verity, which occurred on 6th inst. at Hailey, Wallingford, at the age of 41 years.

## NEW COMPANIES REGISTERED.

**Yorkshire (West Riding) Electric Tramways Co., Ltd.** (84,167).—This company was registered on April 5th, with a capital of £600,000 in £5 shares (70,000 preference), to adopt agreements (1) with the Yorkshire Electric Tramways Construction Syndicate, Ltd., and the Wakefield and District Light Railway Co., and (2) with Dick Kerr & Co., Ltd., and the Yorkshire Electric Tramways Construction Syndicate, Ltd., to construct, lay down, equip, work, and maintain the tramways authorised by the Wakefield and District Light Railway Order, 1901, the Wakefield and District Light Railways (Extensions) Order, 1902, and the West Riding Tramways Act, 1904, or any other tramways and light or other railways in Great Britain, and to carry on the business of tramway and railway proprietors, engineers, electricians, contractors, manufacturers of rolling stock and vehicles, suppliers of electricity, &c. The first subscribers (each with one share) are:—W. H. Brinkworth, 24, Rectory Road, Church Hill, Walthamstow, manager; J. V. Marshall, 96, Talbot Road, Bayswater, manager; J. N. Goldring, 52, Warrington Crescent, W., member of the Stock Exchange; W. J. Forrest, Clyde House, Avenue Road, Wandsworth, clerk; J. A. Fuller, 50, Chatterton Road, Finsbury Park, N., clerk; J. A. Chapman, 78, Algernon Road, Lewisham, S.E., clerk; and H. W. Brown, 63, Mackenzie Road, Beckenham, clerk. Minimum cash subscription, half the share capital offered to the public. The number of directors is not less than three nor more than seven; the first are H. S. Leon, Bletchley Park, Bucks (director of the Anglo-American Telegraph Co.); W. B. Keen, 8, Church Court, Old Jewry, E.C.; G. E. Leon, 5, Throgmorton Street, E.C.; and E. Schenk, 1, Curzon Street, W. (director of Manx Electric Railway Co.); qualification, £500, provided that the first directors shall not require such qualification until the completion of the purchase under agreement (1) and the distribution of the assets of the said Yorkshire Electric Tramways Construction Syndicate, Ltd.; remuneration, £1,500 per annum, divisible.

**Raymond-Phillips Electric Railway and Tramway Equipment Co., Ltd.** (84,128).—This company was registered on April 1st, with a capital of £10,000 in £1 shares, to acquire any patents and rights relating to improvements in connection with overhead electric wires for railways and tramways and screws, in particular to acquire from T. E. R. Phillips the benefit of certain existing inventions relating (1) to an improved construction of mechanical ear for electric trolley wires or the like; (2) to an improved construction of section insulator for electric trolley wires, or the like; (3) to an improved construction of splicing ear for electric trolley wires or the like; and (4) to improvements in connection with screws, and to develop and turn to account the same. The first subscribers are:—W. V. M. Popham, Talbot House, 10, Arundel Street, W.C., consulting electrical engineer, with 100 shares; T. E. R. Phillips 11 and 12, Finsbury Square, E.C., engineer, one share; H. H. F. Collinge, 19, Church Street, Isleworth, gentleman, 100 shares; Major E. Christophers, 16, Regent Street, S.W., one share; G. F. Townley, 265, High Street, Acton, gentleman, 15 shares; G. A. Dwelley, 41, Acton Lane, Harlesden, N.W., gentleman; and A. J. Burrell, 12, Berkley Road, Gravesend, gentleman, 10 shares. Minimum cash subscription, £300. T. E. Raymond-Phillips is the first director; qualification, £50; remuneration as fixed by the company.

**Richardson Electrical Co., Ltd.** (84 179).—This company was registered on April 6th, with a capital of £2,500 in £1 shares (1,000 preference) to carry on the business of electrical, gas and mechanical engineers, electricians, suppliers of electricity, and gas for light, heat, motive power or other purposes, manufacturers of and dealers in all apparatus used in the generation, distribution, supply, accumulation and employment of electricity and gas, &c., and to adopt an agreement with C. P. Richardson and E. H. Walker. The first subscribers (each with one ordinary share) are:—P. C. P. Richardson, 311, Goldhawk Road, W., electrical engineer; F. G. S. Ham, 13, Grosvenor Road, Westminster, mechanical engineer; C. M. Samson, 13, Grosvenor Road, Westminster, engineer; E. H. Walker, Glenhaven, Elstree, Herts, decorative artist; C. Clark, 33, Whitbread Road, Brockley, secretary; W. H. Seal, 63, Castle Buildings, Palace Street, Buckingham Gate, clerk; and E. H. Bence, 19, Rosevine Road, Wimbledon, S.W., engineer. No initial public issue. The number of directors is not to be less than two nor more than five; the first are P. C. P. Richardson, E. H. Walker, F. G. S. Ham and C. M. Samson; qualification, £100. Registered office, 16, Dorset Street, Baker Street, W.

**Oldbury Steel Conduits, Ltd.** (84,113).—This company was registered on March 31st, with a capital of £3,000 in £1 shares, to carry on the business of manufacturers of and dealers in electric conduit tubes, fittings and appliances, iron, steel, brass, copper, metal and composition tubes, makers, engineers, smelters, metal converters, founders, screw, bolt and nut manufacturers, electric engineers, contractors for electric light, heat and power, and for telegraph and telephone installations, &c. The first subscribers (each with one share) are:—W. W. Hackett, 151, Vicarage Road, Langley, engineer; W. O. Lennard, 133, Bromford Lane, West Bromwich, clerk; W. H. Hutchinson, 16, St. Mark's Street, Ladywood, Birmingham, manager; J. Sutton, 26, Whitehall Road, Handsworth, Birmingham, manager; F. Sutton, 50, Hamstead Road, Handsworth, Birmingham, clerk; Clara Sutton, 36, Whitehall Road, Handsworth, Birmingham, clerk; and A. L. Preece, 230, Burbury Street, Lozells, Birmingham, wood engraver. No initial public issue. The first directors are not named. Registered office, Birchfield Lane, Oldbury, Worcestershire.

**Edinburgh Suburban Electric Tramways Syndicate, Ltd.** (5,833).—This company was registered on April 3rd, with a capital of £10,000 in £1 shares, to construct, lease or otherwise acquire, equip, maintain and work by electricity, steam, horse or other power, tramways between any part of Edinburgh or Leith, and any places within the counties of Midlothian, East Lothian and West Lothian, and to carry on in all its branches the business of tramway, railway, omnibus, carriage and van proprietors, carriers of passengers and goods, &c. The first subscribers (each with one share) are:—R. Allan, 10, Minto Street, Edinburgh, merchant; G. Thornton, Grange Park, Dick Place, Edinburgh, manufacturer; R. Hamilton, Trinity Lodge, Edinburgh, iron merchant; J. Brit, Warriston House, Edinburgh, contractor; T. Geddes, 18, Mortonhall Road, Edinburgh, gentleman; R. Portheim, 28, Victoria Street, London, S.W., electrical engineer; and G. Barbour Turnbull, Kilrasock, Blackford Avenue, Edinburgh, stockbroker. The number of directors is to be five; the first are not named; qualification, £100.

## OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

**Premier Electric Lamp Co., Ltd., Huyton Quarry** (66,327).—An agreement, dated January 27th, 1905, extending time for payment of debentures for £12,500, and varying rate of interest thereon, has been registered. Property charged: The company's undertaking and property, present and future. No trustees. Party to agreement on behalf of debenture holders: T. Griffiths.

**Llandudno and Colwyn Bay Electric Traction Co., Ltd.**—Particulars of £60,000 debentures, created by resolution of February 24th, 1905, have been filed, pursuant to Sec. 14 (4) of the Companies' Act, 1900. Property charged: The whole of the company's undertaking and property. No trustees.

**Newcastle-upon-Tyne Electric Supply Co., Ltd.** (27,997).—This company's annual return was filed on March 23rd, when the entire nominal capital of £750,000 in 75,000 preference and 75,000 ordinary shares of £5 each had been taken up. £5 per share has been called up on 64,241 preference and 67,029 ordinary shares, and £656,050 has been received, leaving £300 in arrears. £93,550 is considered as paid on 10,759 preference and 7,971 ordinary. Mortgages and charges: £250,000.

**Smithfield Markets Electric Supply Co., Ltd.** (53,354).—This company's annual return was filed on March 2nd, when 12,000 shares had been taken up out of a nominal capital of £100,000 in 20,000 shares of £5 each. £60,000 has been received. Mortgages and charges: £58,000.

**Notting Hill Electric Lighting Co., Ltd.** (25,921).—This company's annual return was filed on March 23rd, when 10,852 ordinary, 2,998 preference, and 550 founders' shares had been taken up out of a nominal capital of £200,000 in 16,452 ordinary, 2,998 preference, and 550 founders' shares of £10 each. £10 per share has been called up, and £144,000 has been received. Mortgages and charges: £61,000. Mortgages and charges guaranteed jointly by this company and the Kensington and Knightsbridge Electric Lighting Co., Ltd. (issued under powers of the Kensington and Notting Hill Electric Lighting Companies' Act, 1899): £152,500.

**Stanley Electric Carriage Co., Ltd., London** (83,297).—£6,000 6 per cent. debentures, created and dated January 23rd, 1905, charged on the company's undertaking and property, present and future, including uncalled capital, have been registered. No trustees. Holder: Major-General E. H. Sartorius, K.C.B., Old Swan House, Chelsea.

**Electrical Bleaching Co. (1904), Ltd.** (81,614).—Issue, on March 17th, of £2,000 debentures, part of series created December 21st, 1904, to secure £14,000, charged on the company's undertaking and property, present and future, except uncalled capital. No trustees; but title deeds of the company's property are lodged with a safe deposit company, in the joint names of F. R. B. Lindsell (nominee of the board) and J. H. Hayes (nominee of the debenture-holders). Previously issued of same series: £12,000.

**Light Cure and Electro-therapeutic Institute, Ltd.** (78,946).—Issue, on March 9th, of £5 0 debentures, part of series created December 15th, 1904, to secure £1,500, charged on the company's property, present and future, including uncalled capital. No trustees. No previous issue of same series.

**Westminster Electric Supply Corporation, Ltd.** (27,061).—This company's annual return was filed on March 16th, when 110,000 ordinary and 28,151 preference shares had been taken up and paid for in full out of a nominal capital of £800,000 in 110,000 ordinary and 50,000 preference shares of £5 each. Mortgages and charges: £259,000.

**Telegraph Construction and Maintenance Co., Ltd.** (1,147 C).—This company's annual return was filed on March 23rd, when the entire capital of £448,200 in 37,350 shares of £12 each had been taken up and paid for in full. No mortgages or charges.

**St. James's and Pall Mall Electric Light Co., Ltd.** (26 015).—This company's annual return was filed on March 15th, when the entire capital of £300,000 in 40,000 ordinary and 20,000 preference shares of £5 each had been taken up. £5 per share has been called up on 39,650 ordinary and 20,000 preference shares, resulting in the receipt of £298,250. £1,750 is considered as paid on 350 shares. Mortgages and charges: £150,000 3½ per cent. debenture stock and £168,438 4 per cent. guaranteed debenture stock of the Central Electric Supply Co. being half the total loan capital.

**Newcastle and District Electric Lighting Co., Ltd.** (28 022).—This company's annual return was filed on March 14th, when 29,750 shares had been taken up out of a nominal capital of £300,000 in 30,000 shares of £10 each. £9 per share has been called up on 20,000 and £5 per share on 9,750, and £228,649 has been received, leaving £101 in arrears. Mortgages and charges: £86,085.

**Northwich Electric Supply Co., Ltd.** (46,958).—This company's annual return was filed on March 15th, when 3,629 shares had been taken up out of a nominal capital of £25,000 in 5,000 shares of £5 each. £5 per share has been called up, resulting in the receipt of £18,145. Mortgages and charges: £11,000.

**Northampton Electric Light and Power Co., Ltd.** (28,640).—This company's annual return was filed on March 13th, when 10 "A" and 60,284 "B" shares had been taken up out of a nominal capital of £100,000 in 10 "A" and 99,990 "B" shares of £1 each. £1 per share has been called up, resulting in the receipt of £59,060. £1,234 remains in arrears. Mortgages and charges: £41,800.

# CITY NOTES.

## Kalgoorlie Electric Tramways, Ltd.

The report for 1904 shows that the operating profit for the second half of the year was £9,194. Some parts of the system, it is stated, were not completed until a few weeks ago. The cars hitherto in use have proved quite insufficient to cope with the increasing traffic, and more cars and trailers have been ordered. It has also been necessary to give orders for duplication of portions of the track. Up to the present time electrical energy has been supplied under an agreement with the Kalgoorlie Electric Power and Lighting Corporation, the tramways company having the right to terminate the agreement in March, 1907. The price paid to the power company has been 4d. per electrical unit, and although this price may not have been excessive before the Government water supply was in operation, it is now altogether prohibitive. Negotiations with the Kalgoorlie Power Co. have been carried on for some months past with a view to a material reduction in the price of power. The directors are advised that if the company installs its own plant, power can be obtained at 2d. per unit, and if no satisfactory arrangement can be made with the Kalgoorlie Power Co., this course will be adopted.

## Barcelona Tramways Co.

The traffic receipts for 1904 show an increase over 1903 of £15,400, and the working expenses an increase of £1,333. The proportion of working expenses to receipts was in 1903 59·57 per cent., and in 1904 53·49 per cent. The changes in the local administration have undoubtedly conduced to the great improvement. Some of the reforms introduced could not take effect during the first three months of that year, as is evidenced by the increases in the traffics during the first quarter of 1905, amounting to £4,621 for Barcelona and £556 for Ensanche. The balance at the credit of revenue account for 1904, after adding £3,940 received from the Ensanche Co. and the £1,501 from the previous account, is £46,232. Of this sum the interest and sinking funds of the debentures and of the debenture stock have absorbed £16,600, interest on loans £723, and the dividend on the preference shares £5,000. The directors have placed a further sum of £10,000 to renewal fund, raising that fund to £17,000, and they now recommend the payment of a dividend on the ordinary shares at the rate of 6 per cent. per annum (12s. per share), free of income-tax, and that £2,527 be carried forward to next account. The results of the working of the Ensanche Co. covered the full interest of 5 per cent. per annum on the mortgage debt due to this company, and left a surplus of £698, which, in accordance with the terms of the working agreement, was applied in reduction of the capital amount of the mortgage. The total received from the Ensanche on revenue account, including the directors' fees surrendered, and interest, amounted to £3,940.

## Potteries Electric Traction Co.

Mr. G. F. M. Cornwallis-West presided at the annual meeting held at Hamilton House on Tuesday. In moving the adoption of the report (see Electrical Review, April 7th, p. 581), he said that the accounts were exceedingly satisfactory. The directors recommended the payment of the same dividend, placing £500 more to depreciation and reserve, and carrying forward £470; that was in spite of the fact that they had had to pay interest on £25,000 more debentures, and that there were unavoidable increases in certain items of expenditure. The mileage had increased by 1¾ miles, making 30·68 miles. The power and running expenses had increased by £1,173; repairs and maintenance by £1,558, chiefly spent on permanent way and overhead equipment. There was also an increase in administration and general charges, £800 more being paid for rates and increase in insurance. At the last meeting he said that they had entered into a mutual arrangement with other associated companies to deal with the matter of insurance. Unfortunately, the first year, 1903, resulted in a considerable call having to be made owing to several expensive accidents on other systems. This company's proportion was not arrived at until the middle of 1904, and consequently it had to be debited to the 1904 accounts. A call had been made on the 1904 accounts also, and that had been included in the present statement, and would not be carried forward. For the additional expenditure they had run an increased car-mileage of 179,624. The total working expenses per car-mile were 5·59d. as against 5·64d. for the previous year. The working expenses had been reduced from 59 per cent. to 58 per cent. There had been an increase again in the parcels traffic, the number of parcels carried being 209,633, and the receipts had increased correspondingly. Other tramway undertakings, both municipal and otherwise, had taken up this important subject, and the Potteries Co. had been the model in many instances upon which these systems had worked. It was to be hoped that in the near future it would be possible for these concerns to form some sort of combination whereby they could act as each other's agents in the districts they served, and so enormously increase the volume of business, and thus reap the profits now obtained by intermediaries. The carriage of heavier goods was receiving the directors' attention, and application had been made to the local authorities with reference to the construction of sidings to facilitate such traffic, but so far unsuccessfully. They now had an application before the Board of Trade for powers to carry out the work. Last year he suggested that motor-omnibuses would serve a useful purpose by feeding the tramways. This company was just about to start a service between Trentham and Newcastle. It was impossible to say what the results were likely to be. They had agreed to construct several extension lines this year, and might have to purchase a few more cars; for these and some minor matters some further capital would be required during the year.

Mr. E. Garcke seconded the motion, and it was adopted.

## Indo-European Telegraph Co.

The directors report that the agreements between the Postmaster-General, the Imperial German Post Office, and the company, for the leasing of land wires in this country and submarine cable wires between Lowestoft and the German coast, referred to in the last report, have been finally concluded. The lines of the company continue to work efficiently, and the direct Wheatstone working now in operation between London (Manchester and Liverpool) and Teheran, as well as over the company's direct wires to and from South Russia, and over the company's direct line for Continental telegrams from Berlin to and from Teheran, for the East, enables the traffic to be carried with a maximum of speed and accuracy.

The retirement trust fund has been duly established, and the amounts voted by the shareholders have been handed over to the trustees. The company's revenue for the year from all sources amounts to £141,401, as compared with £139,094 for 1903, showing an increase of £2,306. The expenses are—on commercial and general account £47,876, and on maintenance account £24,054; total, £71,930; as against £68,894 for 1903, an increase of £3,036. The revenue account, therefore, shows a balance of £69,471, which is carried to profit and loss account, 1904. Bringing forward the balance of £16,366 from 1903, and deducting income-tax paid (£8,945) and the interim dividend of £10,625, there remains an available balance of £71,267. The directors now propose to declare a dividend for the six months ending December 31st, 1904, of 17s. 6d. per share (making with the interim dividend already paid, 6 per cent. for the year) and a bonus of 20s. per share, both free of income-tax. They also propose to add £15,000 to the equalisation of dividend fund, and to hand over a further sum of £5,000 to the trustees of the retirement trust fund, carrying forward £19,362 to the credit of 1905. The directors do not consider it necessary on this occasion to re-invest for the benefit of the reserve fund the interest accrued, during 1904, upon the investments representing that fund, and, therefore, propose to make a special distribution to the shareholders from this source of £12,750, equivalent to 15s. per share. This distribution also will be free of income-tax.

To the very great regret of his colleagues, Mr. W. S. Andrews has resigned his seat on the board, owing to failing health, having served as manager and secretary, managing director, and director. The company largely owes its present position to Mr. Andrews's knowledge, tact, and unfailing energy, placed ungrudgingly at its disposal over the long period of 34 years. Sir Francis Mowatt, G.C.B., has joined the board in his place.

## British Aluminium Co.

The report for 1904 shows that the profit for the year 1904, transferred to appropriation account, is £55,411. From this has to be deducted the debit balance of £3,837 17s. 10d., brought forward from 1903 (after writing £9 per share off the ordinary shares), and debenture stock interest £15,000, leaving £36,573. Out of this £3,950 has to be set aside for the redemption, with interest, of the deferred commission warrants issued in 1901, leaving an available balance of £32,624. One-fourth of this amount, say £8,156, will be applied in accordance with the debenture stock supplemental trust deed in redeeming and cancelling £8,000 of the debenture stock, and out of the balance the board proposes to apply in paying on July 1st next:—

| | |
|---|---|
| The deferred warrants issued for arrears of dividend to December 31st, 1902, on the "A" preference shares .. .. .. .. | £10,170 |
| A dividend of 6 per cent. per annum on the "A" preference shares for the two years, 1903-1904. .. .. .. .. .. .. | £11,983 |
| A dividend at the rate of 7 per cent. per annum from November 22nd, 1904, to December 31st, 1904, on the 7 per cent. preference shares .. .. .. .. .. .. .. .. .. | £1,500 |
| A dividend of 7 per cent. for the year, 1904, upon the ordinary shares .. .. .. .. .. .. .. .. .. | £700 |

and leave a balance of £115 to be carried forward.

The board proposes to pay off on the same date the deferred warrants issued in 1902 for interest on the debenture stock.

The board last autumn submitted to the shareholders proposals for providing the additional capital necessary for the development of the Loch Leven Power scheme and other purposes. The capital of the company was increased to £500,000 by the creation of £190,000 new ordinary shares, and the board was empowered to issue £300,000 5½ per cent. debentures to be called Loch Leven debentures. To facilitate the issuing of the ordinary shares, the 7 per cent. preference shareholders have accepted 4 per cent. certificates in satisfaction of the accumulated arrears of dividend on their shares to November 22nd last. The new shares, together with the Loch Leven debentures, will be offered for subscription prior to June 30th next.

The company's interest in the Loch Leven Power Scheme has been transferred to the Loch Leven Water and Electric Power Co., as that company must carry out the works under the terms of the Loch Leven Water Power Act. To provide for the cost 50,000 shares of £10 each, part of its capital, will be issued. These will all be subscribed by this company, which will thus own the whole of the issued capital of the Loch Leven Water and Electric Power Co. Plans and specifications for the scheme have been prepared by Messrs. Thomas Meik and Sons, and have been submitted to Sir Alexander Binnie for approval. So soon as this has been obtained tenders will be invited for the carrying out of the works.

The extension of the Foyers Water Power was completed in December last. Since then the whole of the available power there has been employed in the production of aluminium, the demand for which continues to expand steadily.

The meeting is to be held on Tuesday next, 18th inst., at Winchester House.

## Merthyr Electric Traction and Lighting Co.

Mr. W. L. Madgen (chairman) presided on Thursday last week at the offices, Donington House, over the eighth ordinary general meeting of the above company.

In moving the adoption of the report, which showed a sum of £2,301 8s. 9d. available for distribution, the Chairman said that owing to the state of trade in the district the traffic receipts had not increased as they had hoped, but they hoped that with a revival of trade they would have a better return in the current year. The electric supply department was steadily improving from year to year, and they were laying additional mains. It was in that direction that they might probably expect largely increased profits for the company.

Mr. G. Ratcliffe Hulme seconded the motion, and the report was adopted without discussion.

On the motion of the Chairman, seconded by Mr. Hulme, Mr. C. C. Tegetmeier was re-elected a director, and it was also agreed that the directors' remuneration for the year be fixed at £250.

The auditors, Messrs. W. J. Kershaw & Co., were re-elected, and the meeting closed.

## Babcock & Wilcox.

The meeting of this company was held on Tuesday at the Cannon Street Hotel, Mr. John Dewrance presiding.

The Chairman, in proposing the adoption of the report, said it was of a very satisfactory nature. The net result was that they had made a profit of £289,748, to which had to be added the balance brought forward from the last account £26,820 less the 1,000 guineas which was voted last year to the directors, which made a total of £315,519; deducting from that the interim dividend amounting to £45,400 there was left a balance of £270,119 to dispose of at that meeting. The directors recommended that they should pay the 3 per cent. on the preference shares and a dividend of 8 per cent. and a bonus of 4 per cent. on the ordinary shares, and to place £175,000 to the reserve fund. The profits for the past year they regarded as to some extent abnormal, and he hoped they would not always put upon them the onus of always presenting such a favourable report. They must not forget that this was an industrial company, and that while they had exceptionally good periods of trade, as last year had been, they must be prepared for meeting the very severe competition that all industrial concerns were subject to. In their particular case they had the competition of the internal combustion engine and various new types of water-tube boilers which were always being brought out, probably to imitate the success which they had made. He was prepared to say that their success was not necessarily due to the type of boiler they made, but was due in a great measure to the exceedingly successful management of the company. They did not confine themselves to boilers. During the last two or three years they had gone into quite a variety of other classes of work than boilers—conveyers and various accessory fittings, in which they were brought into direct competition with firms who were supposed to be able to cut prices. In all those directions they had succeeded quite as well as they had in their boiler business, and if in the future they had to meet competition, he considered there was no firm in the country better prepared to meet it. The board had stated in the report that, as some of the reserve fund now formed part of the working capital, they had under consideration a proposal that that should be taken from the reserve fund and added to the capital account. He could not give them the details of that scheme at the present meeting, as such a proposal required a good deal of consideration. However, before anything could be done, they would have to call an extraordinary meeting, and if they did that the directors would acquaint the shareholders with the details of the proposal. He was sorry to say that the subsidiary companies that they formed with such great hopes, had not participated altogether in the success that had attended the parent company, and they had had to help them to a limited extent this past year.

Sir Wm. Arrol, M.P., seconded the motion, and the report was adopted.

Following the re-election of the retiring directors, a resolution was unanimously agreed to voting the chairman and directors a bonus of 1,500 guineas for their services.

## Metropolitan Electric Tramways Co.

The report for 1904 states that the total revenue amounted to £113,254, including the dividends on shares held in the North Metropolitan Tramways and the Harrow Road and Paddington Tramways, and the interest on the advances made to the North Metropolitan Electric Power Supply Co. The gross traffic receipts amounted to £81,843, compared with £66,973 for the previous year. The lines now working by electric traction were not opened until the second half of the year, and some of them not until December. The revenue account shows a surplus of £32,283. After deducting the full dividend on the preference shares and providing for the repayment to the British Electric Traction Co. of the balance due to them for the advance made in January, 1903, under their guarantee of the preference share dividend, there remains an available balance of £3,854, which is carried forward. No ordinary dividend has yet been paid. The directors propose to make an issue of ordinary shares at par to the holders of all classes of shares and the debenture stock in the proportion of one ordinary share in respect of every 10 shares or £10 debenture stock held at that date. The shares will be payable by instalments of 5s. on acceptance of allotment, 5s. one month later, and 10s. two months later. The light railway, 4½ miles in length, running along the Great North Road from Highgate Archway to North Finchley will be ready for working shortly after Easter. The two light railways connecting the tramways of the company with the Alexandra Palace will, it is hoped, be ready for working during the summer.

## Kidderminster and District Electric Lighting and Traction Co.

Mr. W. L. Madgen, chairman, presided over the meeting of the above company held on Thursday last week at Donington House.

The Chairman, in moving the adoption of the report, said that as some of them were no doubt aware, the company obtained a Light Railway Order authorising the construction of a light railway from Kidderminster to Bewdley, which was to be similar to the tramway now being operated between Kidderminster and Stourport. A portion of the authorised line went through what was known as the Bull Ring, and a clause was inserted in the Order that they were not to run passengers through that Bull Ring, but were merely to use the line to transfer the cars from one portion of the line to the other. Such a break in the line was felt to be fatal to its success, but they accepted the provision at the time, as they would not have got the Order without it, and they had hoped that in time they would induce the local authority and the Board of Trade to release them from that condition. They had since made many attempts to convince the Town Council that, in the public interest no less than in the financial interest of the line, the omission of the condition was desirable, but they had not been successful. Consequently they had had to intimate to the local authority that it was not their intention to ask the Board of Trade for any extension of time. He thought it was a matter for regret that they were bound to adopt this course, both for the public and the company. The question of the expense which was incurred in the promotion of the Order had received the careful consideration of the directors, and they might probably deem it desirable to put it to a suspense account, and wipe it out over a reasonable term of years. The only other matter to mention was that since the date of the accounts they had made satisfactory arrangements with the British Electric Traction Co., by which that company had taken up £27,500 in 4½ per cent. debenture stock at par. This had enabled the company to settle certain liabilities, and left them for the time being in fairly easy financial circumstances. The Great Western Railway Co. had commenced to run motor-cars between Kidderminster and Stourport, but they did not apprehend that their traffics would be permanently affected by such competition.

Mr Arnold seconded the motion, which was adopted.

The retiring director (Sir E. Spencer) and the auditors were re-elected.

## Calcutta Tramways Co.

This company's meeting was held on Tuesday at the office, 1, Queen Victoria Street, Mr. E. C. Morgan presiding.

In proposing the adoption of the report, the Chairman said that the capital expenditure in the past year had amounted to £56,079. The proportion of expenditure to income had remained almost exactly the same as during the year 1903, *i.e.*, 50 per cent., a result which he thought they would agree was not unsatisfactory. They had run about 80,000 more miles during the year, but the running had been more scientifically adjusted, so that the earnings per mile run had increased by about ¾d. per mile. On the other hand, the running of thick services at the busy hours had naturally required the employment of more motormen, conductors and other members of the staff, so that the expenses per car-mile were also higher by ½d. per mile, but the actual gain had been ¼d. per car-mile, and the greater conveniences offered to their business customers tended to increase their number. Evidence of that was given in the substantial improvement shown by the traffics during the present year, which, for the three months just ended show an increase over the same period last year, without the addition of any route mileage, of about £4,000. Since the beginning of this year an agreement had been signed with the Howrah Municipality for the construction of a system of lines in that important district. It would probably be some little time before the necessary preliminaries which were required before they could actually break ground, could be completed, but they had everything in readiness, and no time would be lost when all the formalities had been complied with. They were also just completing an agreement with the Municipality of Barnagore to construct a line into that northern suburb, and negotiations were well advanced for the extension to the south through Alipore to Behala. With all this work ahead of them it was necessary to make further provision of capital, and with that object a further issue of 35,000 shares was made last month. As this capital would not become dividend earning for some time, it was deemed advisable that it should not rank with the existing capital until January 1st, 1907, and meantime should carry interest at 5 per cent. per annum. With the exception of a few shares the new issue, which was offered to shareholders at par, in the proportion of one share for every three old shares held, had been readily applied for, so that they were now provided, as far as they could see, with ample funds to carry out the work now in sight. They proposed to add a further sum of £8,442 8s. out of the year's profits to the depreciation fund, which, with the sum of £6,557 12s. premium on the sale of the surplus shares of the previous issue, made a total contribution of £15,000 for the year, and brought the amount of that fund to £42,792 12s. 1d. It was extremely satisfactory to the directors to be able to make that recommendation, whilst at the same time paying a dividend at an enhanced rate. It gave the directors much pleasure once more to record their appreciation of the work done by their staff in Calcutta. Mr. Wells, who was present at the last annual general meeting, had now returned to Calcutta and resumed charge from Mr. Pfeiffer, who acted most efficiently during Mr. Wells's absence in England. Thanks to the tact and ability displayed by those gentlemen, the relations of the company with the municipality and the public continued to be of the most friendly character, and the greatest confidence was now felt in Calcutta, that any work undertaken by the company would be carried out in the most complete and satisfactory manner.

Sir Howard Vincent, M.P., seconded the motion, and the report was adopted.

## Cuba Submarine Telegraph Co.

The directors report for the half-year ended December 31st, says that the total receipts were £13,385, while the expenses amounted to £8,369, leaving a balance of £5,446, to which has to be added £4,647 brought forward from last account, giving a total of £10,093 to be dealt with. The dividend on the preference shares will absorb £3,000, and leave £7,093, out of which the directors recommend the payment of a dividend at the rate of 5 per cent. per annum on the ordinary shares, the balance, £3,093, being carried forward. The new cable contracted for with Hooper's Telegraph and India-Rubber Works, was duly laid between Cienfuegos and Santiago de Cuba, and was taken over on February 18th, in perfect condition. The Cape Cruz-Santiago cable has since been repaired and is now in good working order. The Cuban Government having refused payment of the subsidy for the coast cables, the company's agent in Havana has been instructed to appeal to the Court's against the President's decision. The claim against the United States Government for payment of the cost of repairing the damage done to the cables during the Spanish-American war is still unsettled.

## Urban Electric Supply Co.

The report for 1904 shows a profit of £21,117, and after deducting London expenses (including directors' fees), amounting to £1,679, and debenture interest, interest on temporary loans, &c., amounting to £5,236, there remains a balance of profit of £14,202. The amount required to meet the 5 per cent. guaranteed dividends was £19,914, and the sum required for this purpose in excess of the above balance of profit, viz., £5,712, has been duly provided by Edmundson's Electricity Corporation, Ltd., under their contract. Under the terms of this contract provision for depreciation will commence after the year 1906. The working results for the first nine months were satisfactory, but the progress for the last three months of the year, as in many other electric lighting undertakings, did not bear out the promise of the earlier period. This retardation of the growth of profits is only temporary. The Newbury station, which was the only station not completed at the time of the last report, and which was expected to be opened in June, 1904, was not opened until January, 1905, owing to unavoidable delay in completion of the work in connection with the water-power. All the company's stations are now completed and running, and any additional capital expenditure will now only be for extensions required from time to time. The progress of the year will be seen from the table given below:—

| | Equivalent in 8-c.p. Lamps. | | |
|---|---|---|---|
| | Connected Dec. 31, 1902. | Connected Dec. 31, 1903. | Connected Dec. 31, 1904. |
| Hawick .. .. .. .. | 7,319 | 14,101 | 20,644 |
| Stamford .. .. .. .. | 9,166 | 14,687 | 19,595 |
| Weybridge .. .. .. .. | 6,066 | 13,234 | 23,029 |
| Godalming .. .. .. .. | 4,728 | 11,801 | 16,088 |
| Twickenham .. .. .. | 6,769 | 15,439 | 31,409 |
| Dartmouth .. .. .. | 2,470 | 6,610 | 10,305 |
| Camborne and Redruth .. | 11,885 | 25,806 | 30,576 |
| Newton Abbot .. .. .. | — | 4,511 | 9,314 |
| Grantham .. .. .. | — | 16,224 | 26,329 |
| Glossop .. .. .. .. | — | 12,475 | 14,949 |
| Berwick .. .. .. .. | — | 4,154 | 7,339 |
| Caterham .. .. .. .. | — | 1,070 | 5,859 |
| Newbury .. .. .. .. | (Under construction) | | |
| Totals .. .. | 48,403 | 140,112 | 215,376 |

During the year £200,000 4½ per cent. debenture stock has been issued.

The following table also accompanied the report:—

| | Average capital expenditure for 1904. | Profits, 1903. £ s. d. | Profits, 1904. £ s. d. | Date supply commenced. |
|---|---|---|---|---|
| Berwick .. .. .. | £21,718 | 185 9 6 | 415 18 8 | Sept., 1903 |
| Dartmouth .. .. .. | £40,580 | 505 14 11 | 721 7 0 | Oct., 1902 |
| Godalming .. .. .. | £45,312 | 1,246 5 0 | 2,011 10 9 | July, 1902 |
| Glossop .. .. .. | £86,517 | 757 18 1½ | 1,740 0 11 | Aug., 1903 |
| Grantham .. .. .. | £54,015 | 841 13 1 | 1,850 8 6 | May, 1903 |
| Hawick .. .. .. | £50,405 | 2,142 14 0 | 2,183 19 4 | Nov., 1901 |
| Newton Abbot .. .. | £35,430 | 125 9 2 | 1,149 16 8 | Jan., 1903 |
| Stamford .. .. .. | £42,723 | 1,042 6 11½ | 1,206 15 9 | April, 1902 |
| Weybridge and Walton .. | £64,995 | 1,380 19 9 | 1,979 17 6 | May, 1902 |
| Camborne and Redruth . | £109,790 | 3,367 5 3½ | 3,068 15 0 | Oct., 1902 |
| Caterham .. .. .. | £21,640 | (*Loss*) 13 15 11 | 222 14 7 | Oct., 1903 |
| Twickenham and T.E.S. Co., Ltd. .. .. | £101,935 | 1,940 17 6 | 3,901 9 3 | July, 1902 |
| Camborne E.S. Co., Ltd. | £15,912 | 259 17 2½ | 567 13 7 | Oct., 1902 |
| Total profits.. .. | | £19,822 14 7 | £21,020 7 6 | |

The annual general meeting was held on Thursday last week at the Westminster Palace Hotel, S.W.

Mr. J. C. Wigham presided in the absence of Mr. F. E. Gripper.

In moving the adoption of the report and accounts, the Chairman said that they were practically the record of the first full year's working of the company's undertaking. At the beginning of the year, all the works in their towns had been opened with the exception of Newbury, in which place considerable delay had been experienced owing to difficulties in connection with water power. These had now been overcome, and the works were opened in January. They were the only works where they had been able to avail themselves of water power. The results of the year's working were satisfactory, the profits having increased from £13,822 to £21,020, and they would have shown still better if the last three months of the year had been as favourable as the earlier quarters. Owing to the exceptionally fine weather and other causes, the results in the latter part of the year were found by most electric lighting companies to have fallen somewhat short of expectations. It was, however, quite a temporary matter. The increase in the number of lamps connected, as shown in the report, was from 140,000 to 215,000. The revenue had shown an improvement in proportion. Turning to the accounts, he remarked that the profit after deducting head office expenses, including directors', auditors', and trustees' fees, amounted to £19,437 17s. 5d. Debenture and loan interest had absorbed £5,101 12s. 3d, and a small loss in realising consols deposited in connection with the tramway undertakings had been £134 11s., leaving a balance of £14,201 14s. 2d. available for dividend. The amount which had been required to pay the 5 per cent. guaranteed dividend on both preference and ordinary shares was £19,914 1s. 9d. The balance of £5,712 7s. 7d. had been paid by Messrs. Edmundson's under their contract. The dividends on both classes of shares had been paid on the fixed dates. The question of depreciation was mentioned at the last meeting, and as he then explained it was not expected that a provision for such a purpose could be provided for during the very early years of undertakings such as theirs. Under the terms of their contract with Messrs. Edmundson's, provision for depreciation would commence in about two years' time. In the meantime everything was kept in perfect order and repair out of revenue, and there was a maintenance contract in force for the accumulators. The local authorities also affected the question of depreciation. They would see from the balance-sheet that the capital expenditure had increased from £586,000 last year's figure, to £822,000. It was a large increase, and heavy expenditure had been incurred for the completion of their various stations, including some large extensions in some of the towns, more especially in Twickenham, Teddington and Walton. They must always look forward to additional capital expenditure to provide for extensions, but now that their works were all fairly well started, the capital expenditure would be on a smaller scale. The directors were considering the best method of providing the additional capital which was required for works already carried out. In conclusion, the chairman referred to the difficulty in regard to the supply at Walton, and remarked that he believed that their Bill had the previous night passed the House of Commons third reading.

The motion was seconded by Mr. William Page and carried.

The retiring directors, Messrs. Wigham and Charrington, having been duly elected, the proceedings terminated.

## Buenos Ayres and Belgrano Electric Tramways Co.

The annual meeting was held on 6th inst., at River Plate House, E.C., Mr. J. B. Concanon presiding. In moving the adoption of the report, which recommended 4 per cent. for the year, with £2,086 carried forward, he said that the receipts showed an increase of £6,558, equal to 4 per cent. on the gross. This was satisfactory, bearing in mind the loss of £1,400 due to the strike in November. The increase in expenditure had been £1,083, and the increased mileage 19,504. The capital expenditure had increased by £17,441, spent upon 15 new cars, and the Nunez extension. By shortening the hours of labour, and altering the scale of wages, there was an extra expenditure of £3,300 to be borne. There were 1½ miles of extension yet to be opened. They had applied for further extension powers—some 4½ miles of double track—which they would carry out if they could arrange reasonable terms with the municipality.

The report was adopted.

## Prospectuses.

The public has this week been asked to subscribe for 7,500 shares of $150 each in the Montreal Light, Heat and Power Co. at 92 per cent.

Messrs. G. M. Callender & Co., Ltd., whose name is familiar as that of the suppliers of bitumen sheeting, &c., has this week been offering 25,000 preference shares (6 per cent. *cum.* £1 each) for subscription. The new capital is required for establishing factories abroad and extending the business generally. The list closes to-day.

Another prospectus published this week is that of the Yorkshire (West Riding) Electric Tramways Co., Ltd, offering £275,000 4½ per cent. first debenture stock at 95 per cent. It will be remembered that the first part of the company's system was opened in August last year. The present is a new company formed, with a share capital of £600,000, to take over the undertaking, &c., of the Wakefield and District Light Railway Co. at £658,000, to be satisfied by the issue of £180,000 preference and £200,000 ordinary shares, fully paid, and the undertaking of liabilities estimated at £278,000, this company also carrying out the completion and equipment of the remainder of the system.

The Shawinigan Water & Power Co., of Montreal, is issuing $2,000,000 of 5 per cent. cons. first mortgage bonds, at 98 per cent. The list of applications closes to-morrow (Saturday).

**Eastern Extension Telegraph Co.**—The directors recommend a dividend for the quarter ended December 31st last, of 2s. 6d. per share, together with a bonus of 4s. per share, making a total distribution of 7 per cent. for 1904.

**Primitiva Gas and Electric Lighting Co. of Buenos Aires.**—The report for the year 1904 states that the balance of revenue account and the interest received from the German Trans-Atlantic Electricity Co. amounts to £115,386, making, with the balance brought forward, a total of £132,071. The directors recommend a divided of 6s. per share, equal to 6 per cent. for the year, on the ordinary shares, leaving £16,469 to be carried forward.

**Stock Exchange Notices.**—The Committee has been asked to allow the following securities to be quoted in the Official List:—Newcastle-upon-Tyne Electric Supply Co., Ltd., 57,009 ordinary shares of £5 each, fully paid, 17,991 ordinary shares of £5 each, 57,009 5 per cent. preference shares of £5 each, fully paid, and 17,991 5 per cent. preference shares of £5 each.

**Calcutta Electric Supply Corporation.**—The directors have decided to recommend a dividend, payable on May 6th, at the rate of 10 per cent. per annum for the half-year ended December 31st last, making, with the interim dividend, 8 per cent. for the year.

**Cuba Submarine Telegraph Co.**—The directors recommend a dividend at the rate of 5 per cent. per annum for the past half-year on the ordinary shares.

**Anglo-American Telegraph Co.** — After placing £5,000 to the credit of the renewal fund, it is proposed to pay an interim dividend for the quarter ending March 31st, 1905, of 15s. per cent. on the ordinary stock, and £1 10s. per cent. on the preferred stock, payable on May 1st.

## STOCKS AND SHARES.

Wednesday Evening.

Stock Exchange markets are under the influence of foreign politics to an unwonted extent. The Budget should have had a rather inspiring effect upon investment prices, and the supply of floating cash is sufficient to encourage the hope of cheaper money. But these factors are not strong enough to combat the restraint imposed upon business by the drawing together of the two hostile fleets in Far Eastern waters. Everyone believes that the Japanese will add one more to their many triumphs in the war, but until faith becomes fact the investor prudently prefers to wait a bit before launching more money in Stock Exchange directions.

New issues of heavy dimensions are, of course, responsible in no small degree for the check administered to investment buying at the end of March, but although the stream of fresh offers has somewhat stopped, it continues to run steadily amongst electrical markets. There is the £275,000 4½ per cent. Debenture stock of Yorkshire (West Riding) Electric Tramways, the 7,500 100-dollar shares of the Montreal Light, Heat and Power Co., the £350,000 in Ordinary and Preference shares issued by the County of Durham Electrical Power Distribution, to say nothing of impending emissions that are to be made by Bruce Peebles & Co., the Metropolitan Electric Tramways Co. and others.

The first-mentioned prospectus is clean-looking and offers good security, but we are in entire accord with the criticism levelled at the position of the directors who also hold interests in the syndicate which is selling its property to this Yorkshire (West Riding) Electric Tramways at a good profit. The Montreal shares were offered at the equivalent of 92 per cent., and the undertaking is really an amalgamation of seven concerns engaged in supplying electric light, power, &c., to Montreal and its vicinity. County of Durham Electrical Preference shares are quoted at a premium of 7s. 6d.; we have not heard a price named for the ordinary. Although the current quotation for Bruce Peebles' old Preference is not better than five middle, the underwriting of a new issue at par, £5, was promptly completed. The Metropolitan Electric Tramways Co. is about to make an issue of Ordinary shares at par to its shareholders.

Besides these additions to the circle of electrical financial interest, there are several little-known securities creeping into popular notice. As one example, we may instance the 5 per cent. gold bonds of the Mexican Light and Power Co., now being dealt in at 89—a good speculative investment. Somewhat similar are the 5 per cent. gold bonds of the Sao Paulo Tramway Light and Power Co., a Canadian concern operating in Brazil. The 4½ per cent. Debentures of the Midland Electric Corporation for Power Distribution have risen from 94 to par, and Telephone Co. of Egypt 4½ per cent. Debenture is firm at 103½. These examples give some idea of the cosmopolitan way in which electrical investments are spreading their interests in the field of finance.

Returning to more beaten paths, the home electrical supply market is all but stagnant. London Electrics of both kinds are ¼ down, and Westminster Preference yielded the like fraction to 6¾, while Notting Hill Debenture lost 2 points at 101. Manufacturing shares are almost equally motionless; Electric Construction Ordinary are 1½ again, and Edison Second Debenture shed a point. Other Miscellaneous descriptions remain steady. Henley's are still dullish, the Ordinary moving down to 12—a 10s. fall—and Babcock's shaded off to 4$\frac{13}{16}$, after their smart advance. The meeting produced a somewhat warning speech from the chairman. Westinghouse Preference continue quietly at 3, the 4 per cent. Debenture stock at 92, and British Thomson-Houston 4½ per cent. Debenture at par.

On Tuesday the chairman of the Anglo-Argentine Tramways announced, at the meeting, the directors' intention of issuing more capital. The price of the Ordinary is unchanged at 8$\frac{13}{16}$, but the Preference are better at 5⅞. Calcuttas eased off a trifle to 8⅝; but Calcutta Electric Supply are better at 9½, upon the declaration of a final dividend, making 8 per cent. for the year. The company still pursues its policy of extension. British Electric Traction Second Debenture fell 1 per cent., the Ordinary resting at their lowered level of 9½. Perth (W.A.) Electric Tramways Debenture sold at 107, Colombo Electric Tramways and Lighting Debenture at 104½, and Auckland Debenture at 106¼; all these are 5 per cent. stocks.

Weakness born of inanition is the only feature amongst Telegraph stocks and shares. Anglo-American Preferred fell ½ to 107½, and the Deferred ⅛ to 15⅝, despite the improvement in the dividend, and the Eastern groups have small declines to show. Western Telegraphs fell ¼ to 13⅜, and West India and Panama at ¾ are ½ down, the First Preference losing 5s. at 8½. Cuba Telegraphs have suffered in the same way, and Great Northern slumped 30s. to 28 after their heavy advance, although Indo-Europeans maintain their recent buoyancy, adding another £2 to their price at 52. Globe Ordinary fell ⅛ to 10⅜. Reuters are again ¼ up at 8 middle. The only Telephone changes are falls of 2 in National Deferred, making the price 101, and of ½ in the Preferred, lowering it to 109.

Railway varieties follow in the wake of Consols. Electrical stocks withstand the prevalent depression fairly well, but Central London Deferred eased off to 83½. Districts at 41, and Metropolitans at 96⅜ are both a fraction down. Baker Street and Waterloo stock settled for the first time this week with 75 per cent. paid. There is another 21 per cent. to pay, and the price is 2⅜ premium. The stock received an official quotation this, Wednesday, evening for the first time. The two newer Tube issues will probably settle early in May.

# SHARE LIST OF ELECTRICAL COMPANIES.

## TELEGRAPH AND TELEPHONE COMPANIES.

| Present Issue. | NAME. | Stock or Share. ‡ | Dividends for the last three years. 1903. | 1903. | 1904 | Closing Quotations April 5th. | Closing Quotations April 12th. | Business done week ended April 12th, 1905. Highest | Lowest |
|---|---|---|---|---|---|---|---|---|---|
| 84,800 | African Direct Telegraph, 4 % Debs. | 100 | 4 % | 4 % | 4 % | 99 —102 | 99 —103 | .. | .. |
| 25,000 | Amazon Telegraph Co.'s shares, Nos. 1 to 25,000 | 10 | Nil | Nil | Nil | 2¼— 2⅜ | 2¼— 2⅜ | .. | .. |
| 119,700‡ | Do. do. 5 % Debs., Nos. 1 to 1,250 Red. | 100 | Nil | Nil | Nil | 7⅛ — 77 | 72 — 77 | .. | .. |
| 768,580 | Anglo-American Telegraph | Stock | 60/6 | 61s. | 2⅜% | 61 — 63 | 61 — 63 | 62 | .. |
| 5,118,210 | Do. do. do. 6 % Pref. | Stock | 6 % | 6 % | 5¼% | 107⅛ —108½ | 107 —108 | 108 | 107 |
| 5,118,210 | Do. do. do. Deferred | Stock | 1/- | 2s. | Nil | 15⅝ — 15¾ | 15⅝ — 15⅞ | 16 | 15⅞ |
| 44,000 | Chili Telephone, Nos. 1 to 44,000 | 5 | 6 % | 7 % | .. | 6⅜— 6⅝ | 6⅜— 6⅝ | 6⅝ | .. |
| 15,000,000 § | Commercial Cable | £100 | 8 % | 8 % | 8 % | 230 —240 | 230 —240 | .. | .. |
| 1,932,856‡ | Do. do. Sterling 500 year 4 % Deb. Stock Red. | Stock | 4 % | 4 % | 4 % | 97 — 99 xd | 97 — 99 xd | 98⅜ | 97⅛ |
| 16,000 | Cuba Telegraph | 10 | 6¼% | 5 % | 5 % | 8⅜— 9¼ | 8¼— 9 | .. | .. |
| 6,000 | Do. 10 % Pref. | 10 | 10% | 10% | 10% | 17 — 18 | 17 — 18 | .. | .. |
| 12,981 | Direct Spanish Telegraph, Ord. | 5 | 4 % | 4 % | 4 % | 3⅜— 3⅝ xd | 3⅜— 3⅝xd | .. | .. |
| 6,000 | Do. do. 10 % Cum. Pref. | 50 | 10% | 10% | 10% | 8¼— 9 | 9⅛— 9 xd | .. | .. |
| 80,000 | Do. do. 4½ % Debs. | 20 | 4½% | 4½% | 4½% | 101 —103⅝ | 101 — 103 | .. | .. |
| 60,710‡ | Direct United States Cable | 100 | 3¾% | 3 % | 4½% | 11⅜ — 11⅝ | 11⅜ — 11⅝ | 11⅞ | .. |
| 78,500 | Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red. | Stock | 4½% | 4½% | 4½% | 100 —102 | 100 —102 | .. | .. |
| 4,000,000 | Eastern Telegraph, Ord. Stock | 100 | 7 % | 7 % | .. | 143 —146 | 141 —144 | 144 | 142½ |
| 2,000,000 | Do. 3½ % Pref. Stock | 100 | 3½% | 3½% | .. | 92 — 94 | 92 — 94 | 93½ | 93 |
| 1,836,814 | Do. 4 % Mort. Deb. Stock Red. | Stock | 4 % | 4 % | 4 % | 108 —110 | 108 —110 | 109½ | 108⅝ |
| 400,000 | Eastern Extension, Australasia, and China Telegraph | 10 | 7 % | 7 % | 7 % | 14⅜— 14⅝ | 14 — 14½ | 14⅝ | 14⅜ |
| 602,400 | Do. 4 % Deb. Stock | Stock | 4 % | 4 % | 4 % | 105 —107 | 105 —107 | .. | .. |
| 800,000 | Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909 | 100 | 4 % | 4 % | 4 % | 100 —102 | 100 —102 | .. | .. |
| 200,000‡ | Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000 | 25 | 4 % | 4 % | 4 % | 101 —103 | 101 —103 | .. | .. |
| 180,887 | Globe Telegraph and Trust | 10 | £3 1s 7* | 6¼% | .. | 10⅜— 11 | 10⅜ — 10⅞ | 10½ | 10½ |
| 180,887 | Do. do. 6 % Pref. | 10 | 6 % | 6 % | .. | 14⅜ — 14⅞ | 14⅜ — 14⅝ | 14⅝ | 14⅜ |
| 150,000 | Great Northern Telegraph, of Copenhagen | 10 | 12½% | 15 % | 24 % | 38½ — 40½ | 37 — 39 | 38½ | .. |
| 80,000 | Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red. | 100 | 4½% | 4½% | 4½% | 100 —102 | 100 —102 | .. | .. |
| 17,000 | Indo-European Telegraph | 25 | 10% | 10 % | 13 % | 49 — 51 | 51 — 53 | 51 | 50½ |
| 72,680 | Monte Video Telephone Co., Ltd., Ord. | 1 | 3 % | 3 % | .. | ⅛— ¼ | ⅛— ¼ | .. | .. |
| 1,983,333 | National Telephone, Pref. Stock | 100 | 6 % | 6 % | 6 % | 109 —110 | 102½—109½ | 109⅝ | 109 |
| 1,966,667 | Do. do. Def. Stock | 100 | 4½% | 5 % | 5 % | 102 —104 | 100 —102 | 103⅜ | 100½ |
| 15,000 | Do. do. 6 % Cum. 1st Pref. | 10 | 6 % | 6 % | 6 % | 12½— 13½ | 12½ — 13½ | .. | .. |
| 15,000 | Do. do. 6 % Cum. 2nd Pref. | 10 | 6 % | 6 % | 6 % | 11⅛ — 12⅛ | 11⅛ — 12⅛ | .. | .. |
| 250,000 | Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000 | 5 | 5 % | 5 % | 3½% | 5⅛ — 5⅜ | 5⅛ — 5⅜ | 5⅜ | .. |
| 4,000,000 | Do. do. 3½ % Deb. Stock Red. | Stock | 3½% | 3½% | 4 % | 100 — 102 | 100 — 102 | 100½ | 100½ |
| 1,989,598 | Do. do. 4 % Deb. Stock Red. | 100 | 4 % | 4 % | 4 % | 103½—105½ | 103¾—105½ | 104⅛ | 103⅜ |
| 179,318 | Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid | 1 | 6 % | 6½% | 6½% | 1½ — 1⅝ | 1⅝ — 1¾ | 1½ | .. |
| 50,000 | Do. do. do. 6 % Cum. Pref. | 1 | 6 % | 6 % | 6 % | 1⅝— 1⅞ | 1⅝— 1⅞ | 1½ | .. |
| 100,000 | Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 | 100 | 4 % | 4 % | 4 % | 99 —102 | 99 —102 | .. | .. |
| 11,889‡ | Reuter's | 8 | 5 % | 5 % | .. | 7⅞ — 8 | 7⅞ — 8⅛ | .. | .. |
| 8,237 | Submarine Cables Trust | Cert. | 6 % | 6 % | 6 % | 125 —128 | 125 —128 | .. | .. |
| 58,000 | United River Plate Telephone | 5 | 7 % | 8 % | .. | 7 — 7⅛ | 7 — 7⅛ | .. | .. |
| 40,000 | Do. do. 5 % Cum. Pref., Nos. 1 to 40,000 | 5 | 5 % | 5 % | .. | 5 — 5⅛ | 5 — 5⅛ | 5⅛ | .. |
| 179,947 | Do. do. 5 % Debs. | Stock | 5 % | 5 % | 5 % | 107 —109 | 107 —109 | .. | .. |
| 15,609‡ | West African Telegraph, Shares | 10 | 2 % | 4 % | .. | 8 — 8½ | 8 — 8½ | 8½ | .. |
| 30,008 | West Coast of America, 1 to 30,000 and 53,001 to 58,008 | 2½ | Nil | Nil | .. | ⅝— ¾ | ⅝— ¾ | .. | .. |
| 150,000 | West Coast of America, 4% Debs., 1 to 1,500 guar. by Braz. Sub. Tel. | 100 | 4 % | 4 % | 4 % | 100 —102 | 100 —102 | .. | .. |
| 207,980 | Western Telegraph, Ltd., Nos. 1 to 207,980 | 10 | 7 % | 7 % | .. | 13½— 14½ xd | 13¾— 14 xd | 13⅞ | 13½ |
| 75,000 | Do. do. 5 % Debs. 2nd series, 1906 | 100 | 5 % | 5 % | 5 % | 101 —103 | 101 —103 | .. | .. |
| 553,380 | Do. do. 4 % Deb. Stock Red. | 100 | 4 % | 4 % | 4 % | 103 —105 | 103 —105 | .. | .. |
| 88,321 | West India and Panama Telegraph | 10 | Nil | Nil | .. | ⅛— ⅜ | ⅛— ⅜ | ¾ | .. |
| 84,568 | Do. do. do. 6 % Cum. 1st Pref. | 10 | 7 % | 7 % | .. | 8¼— 9 | 8⅛— 8⅝ | .. | .. |
| 4,669 | Do. do. do. 6 % Cum. 2nd Pref. | 10 | Nil | Nil | .. | 8 — 8½ | 8 — 8⅛ | .. | .. |
| 80,000‡ | Do. do. do. 5 % Debs., Nos. 1 to 1,600 | 100 | 5 % | 5 % | 5 % | 103 —105 | 103 —105 | .. | .. |

## ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 43,000 | British Aluminium 7 % Cum. Pref. | 5 | Nil | Nil | Nil | 4⅜— 5⅛ | 4⅜— 5⅛ | .. | .. |
| 40,000 | Do. do. "A" 6 % Cum. Pref. | 5 | Nil | Nil | Nil | 4¼— 5¼ | 4¼— 5¼ | .. | .. |
| 800,000‡ | Do. do. 5% 1st Mort. Deb. Stock Red. | Stock | 5 % | 5 % | 5 % | 99 — 103 | 91 —103 | 103 | .. |
| 133,301 | British Electric Traction | 10 | 8 % | 6 % | .. | 9 — 9½ | 9 — 9⅛ | 9⅛ | 9⅛ |
| 156,437 | Do. do 6 % Cum. Pref. | 10 | 6 % | 6 % | .. | 10¾— 11¼ | 10¾— 11¼ | 11⅛ | 10¾ |
| 1,000,000‡ | Do. do. 5 % Perpetual Debenture Stock | Stock | 5 % | 5 % | 5 % | 121 —123 xd | 120 —122 | 121⅜ | .. |
| 250,000 | Do. do. 4½% 2nd Deb. Stock Red. | 100 | .. | .. | 4½% | 98 — 100 | 98 — 100 | 98⅜ | 98½ |
| 100,000 | British Insulated and Helsby Cables | 5 | 10 % | 8 % | 8 % | 5⅜— 6 | 5⅜— 6 xd | 5⅜ | 5⅜ |
| 100,000 | Do. do. 6 % Cum. Pref. | 5 | 6 % | 6 % | 6 % | 5⅜— 6 | 5⅜— 6 | 5⅜ | .. |
| 500,000 | Do. do. 4½ % 1st Mort. Deb. Red. | 100 | 4½% | 4½% | 4½% | 101 —104 | 101 —104 | .. | .. |
| 60,000 | ¶Browett, Lindley & Co., Ord. | £1 | Nil | Nil | Nil | ⅞— 1 | ⅞— 1 | .. | .. |
| 60,000 | ¶ Do. do. 6 % Cum. Pref. | £1 | Nil | Nil | Nil | 14/6 to 15/6 | 14/6 to 15/6 | .. | .. |
| 105,731 | Brush Electrical Engineering, Ord., 1 to 105,731 | 2 | Nil | Nil | .. | ½— ¾ | ½— ¾ | .. | .. |
| 150,000 | Do. do. Non-cum. 6 % Pref. | 2 | 6 % | 6 % | .. | 1⅛— 2 | 1⅛— 2 | .. | .. |
| 125,000‡ | Do. do. 4½ % Perp. Deb. Stock | Stock | 4½% | 4½% | 4½% | 92 — 95 | 92 — 95 | .. | .. |
| 125,000‡ | Do. do. 4½ % Perp. 2nd Deb. Stock | Stock | 4½% | 4½% | 4½% | 79 — 82 | 79 — 82 | .. | .. |
| 85,000 | Callender's Cable Construction shares | 5 | 15 % | 12½% | .. | 11 — 11½ | 11 — 11½ | .. | .. |
| 40,000 | Do. do. do. 5 % Cum. Pref. | 5 | 5 % | 5 % | .. | 5¼— 5⅜ | 5⅛— 5⅜ | .. | .. |
| 803,000 | Do. do. do. 4½ % 1st Mort. Deb. Stock Red. | Stock | 4½% | 4½% | 4½% | 107 —109 | 106 —108 | 109 | 108½ |
| 1,963,208 | Central London Railway, Ord. Stock | Stock | 4 % | 4 % | 4 % | 92 — 94 | 92 — 94 | 92 | .. |
| 523,396 | Do. do. 4 % Pref. Stock | Stock | 4 % | 4 % | 4 % | 101 —103 | 101 —103 | .. | .. |
| 523,396 | Do. do. Def. do. | Stock | 4 % | 4 % | 4 % | 83 — 86 | 82 — 85 | 84½ | .. |
| 1,330,000 | City and South London Railway | Stock | 2¾% | 2¾% | 2¾% | 44 — 45 | 44 — 45 | 44½ | 44 |
| 85,000 | Crompton & Co., Nos. 1 to 85,000 | 8 | 5 % | 2¾% | .. | 2⅜ — 2⅝ | 2⅜ — 2⅝ | .. | .. |
| 100,000‡ | Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red. | .. | 5 % | 5 % | 5 % | 93 — 98 | 93 — 98 | .. | .. |
| 99,261 | Edison & Swan United Elec. Light, "A" shares, £8 paid, 1 to 99,261 | 5 | Nil | Nil | .. | 1 — 1½ | 1 — 1½ | .. | .. |
| 17,189 | Do. do. "A" shares, 01—017,189 | 5 | Nil | Nil | .. | 1⅜— 2⅛ | 1⅜— 2⅛ | .. | .. |
| 844,028‡ | Do. do. 4 % Deb. Stock Red. | 100 | 4 % | 4 % | 4 % | 80 — 85 | 81 — 85 | .. | .. |
| 100,000‡ | Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd. | 100 | 5 % | 5 % | 5 % | 86 — 90 xd | 84 — 89 xd | .. | .. |
| 112,100 | Electric Construction 1 to 112,100 | 2 | 4 % | 4 % | .. | 1⅛— 1½ | 1 — 1½ | 1⅜ | .. |
| 81,890 | Do. do. 7 % Cum. Pref., 1 to 81,890 | 2 | 7 % | 7 % | .. | 2½— 2⅝ | 2⅜ — 2⅝ | 2⅜ | .. |
| 210,000 | Do. do. 4 % Perp. 1st Mort. Deb. Stock | Stock | 4 % | 4 % | 4 % | 97 — 99 | 97 — 99 | .. | .. |
| 35,000 | General Electric Co. (1900), 5 % Cum. Pref. | 10 | 5 % | 5 % | .. | 9½— 10 | 9⅛ — 10 | 9⅛ | .. |
| 900,000 | Do. do. 4 % Mort. Deb. | Stock | 4 % | 4 % | 4 % | 97 — 101 xd | 97 — 101 xd | .. | .. |
| 200,000 | Henley's (W. T.) Telegraph Works, Ord. | 5 | 20 % | 15 % | 15 % | 12⅛ — 12⅜ | 11⅞ — 12⅛ | 12 | 11⅞ |
| 200,000 | Do. do. 4½ % Pref. | 5 | 4½% | 4½% | 4½% | 5⅝ — ⅝ | 5⅝— ⅝ | 5⅝ | ⅝ |
| 45,900 | Do. do. 4½ Mort. Deb. Stock | Stock | 4½% | 4½% | 4½% | 109 —111 | 102 —111 | .. | .. |
| 50,000 | India-Rubber, Gutta-Percha & Telegraph Works | 10 | 10 % | 10% | .. | 16 — 17 | 16 — 17 | 16 | .. |
| 850,000‡ | Do. do. do. 4 % 1st Mort. Deb. | 100 | 4 % | 4 % | 4 % | 103—103 xd | 100 —103 | .. | .. |
| 37,500 | †Liverpool Overhead Railway, Ord. | 10 | 1⅞ % | 1⅞% | 1½% | 3½— 3⅝ | 3½— 3⅝ | .. | .. |
| 10,000 | † Do. do. Pref. £10 paid | 10 | 5 % | 5 % | 5 % | 9½— 9⅝ | 9½— 9⅝ | .. | .. |
| 87,850 | Telegraph Construction and Maintenance | 12 | 20 % | 20 % | 15 % | 38 — 38 | 36 — 38 | 37½ | 37½ |
| 150,000‡ | Do. do. 4 % Deb. Bds., Nos. 1 to 1,500. Red. 1909 | 100 | 4 % | 4 % | 4 % | 103—105 | 103 —105 | .. | .. |
| 540,000‡ | Waterloo & City Railway, Ord. Stock | 100 | 3½% | 3½% | 3½% | 92 — 94 | 92 — 94 | .. | .. |

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

Bank rate of discount 2½ per cent. (March 9th, 1905).

## SHARE LIST OF ELECTRICAL COMPANIES (*continued*).— ELECTRICITY SUPPLY COMPANIES.

| Present issue. | NAME. | Stock or Share. | Dividends for the last three years 1902. | 1903 | 1904. | Closing Quotations April 5th. | Closing Quotations April 12th. | Business done week ended April 12th, 1905. Highest | Lowest |
|---|---|---|---|---|---|---|---|---|---|
| 29,877 | Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 .. | ‡ 5 | 8 % | 10 % | 10 % | 9¾ — 10¼xd | 9¾ — 10¼xd | .. | .. |
| 10 623 | Do. do. 7 % Cum. Pref. .. | 5 | 7 % | 7 % | 7 % | 9¾ — 10¼ | 9¾ — 10¼ | .. | .. |
| 288,782 | Central Electric Supply 4 % Guar. Deb. Stock .. .. .. .. | 100 | 4 % | 4 % | 4 % | 105 —108 | 105 —108 | .. | .. |
| 80,000 | Charing Cross and Strand Electricity Supply .. .. .. .. | 5 | 10 % | 8 % | 8 % | 7⅞ — 8⅛ | 7⅞ — 8⅛ | 7⅞ | 7⅞ |
| 80,000 | Do. do. 4½% Cum. Pref. .. | 5 | 4½% | 4½% | 4½% | 5⅜ — 5⅝ | 5⅜ — 5⅝ | .. | .. |
| 40,000 | Do. do. "City Undertaking" 4½% Cum. Pref. .. | 5 | 4½% | 4½% | 4½% | 5 — 5⅛ | 5 — 5⅛ | .. | .. |
| 40,000 | Do. do. 1903 .. .. .. .. .. | 5 | .. | 4½% | 4½% | 5 — 5⅛ | 5 — 5⅛ | 5 1/16 | .. |
| 350,000 | Do. do. 4 % Deb. Stock Red. .. .. .. .. | 100 | 4 % | 4 % | 4 % | 105 —107 | 105 —107 | 106¼ | .. |
| 44,486 | *Chelsea Electricity Supply, Ord. .. .. .. .. .. | 5 | 4⅛ % | 5⅛ % | 6 % | 6⅛ — 7 | 6⅛ — 7 | .. | .. |
| 150,000‡ | Do. do. % Deb. Stock Red. .. .. .. .. | Stock | 4½% | 4½% | 4½% | 109 —111 | 109 —111 | .. | .. |
| 70,595 | City of London Electric Lighting, Ord. 40,001—110,595 .. .. | 10 | 5 % | 5 % | 6 % | 11 — 12 | 11 — 12 | .. | .. |
| 40,000 | Do. 6 % Cum. Pref., 1 to 40,000 .. .. .. .. | 10 | 6 % | 6 % | 6 % | 12⅛ — 14 | 13⅛ — 14 | .. | .. |
| 400,000‡ | Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid .. .. | .. | 5 % | 5 % | 5 % | 123 —127 | 123 —127 | .. | .. |
| 800,000 | Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid .. .. | 100 | 4½% | 4½% | 4½% | 103 —105 | 103 —105 | .. | .. |
| 40,000 | County of London Electric Lighting, Ord. 1—40,000 .. .. .. | 10 | 4 % | 4 % | 4⅛ % | 9 — 9⅛xd | 9 — 9⅛ xd | 9⅛ | 9 |
| 80,000 | Do. do. do. 6 % Pref., 40,001—60 .. | 10 | 6 % | 6 % | 6 % | 12 — 12⅛xd | 12 — 12⅛xd | 12 1/16 | .. |
| 400,000‡ | Do. do. 4½% Deb. Stock .. .. .. .. .. | .. | 4½% | 4½% | 4½% | 110 —113 | 110 —113 | .. | .. |
| 950,000 | Do. do. 4½% 2nd Deb. Stock .. .. .. .. | Stock | 4½% | 4½% | 4½% | 104 —106 | 104 —106 | 105 | .. |
| 70,000 | Edmundson's Electric Corporation, Ord. Shares .. .. .. | 5 | 7 % | 7 % | .. | 6 — 6⅛ | 6 — 6⅛ | 6⅛ | 6 |
| 80,000 | Do. do. 6 % Cum. Pref. .. .. .. | .. | 6 % | 6 % | .. | 6⅛ — 6⅜ | 6⅛ — 6⅜ | .. | .. |
| 800,000‡ | Do. do. 4½% 1st Mort. Deb. Stock .. | 100 | 4½% | 4½% | 4½% | 106 —108 | 106 —108 | .. | .. |
| 21,000 | Kensington and Knightsbridge Electric Ord. .. .. .. .. | 5 | 10 % | 12½ % | 12 % | 12 — 13 | 12 — 13 | .. | .. |
| 136,000 | Do. do. do. 4 % Debenture Stock .. | Stock | 4 % | 4 % | 4 % | 101 —103 xd | 101 —103 xd | .. | .. |
| 1 1,000 | London Electric Supply Corporation, Limited, Ord. .. .. .. | 3 | Nil | Nil | 3 % | 2⅛ — 3 | 2⅛ — 3⅜ | .. | .. |
| 6?,0 0 | Do. do. do. 6 % Pref. .. .. .. | 5 | 6 % | 6 % | 6 % | 5⅛ — 6 | 5⅛ — 5⅞ | 5⅞ | .. |
| 371,895 | Do. do. do. 4 % 1st Mort. Deb. Stock Red | Stock | 4 % | 4 % | 4 % | 99 —101 | 99 —101 | 99 | .. |
| 100.000 | Metropolitan Electric Supply, 1 to 100,000 .. .. .. .. .. | 10 | 7½ % | 8⅜% | 10 % | 17⅛ — 18½ | 17⅛ — 18½xd | 18 3/8 | 17¾ |
| 76,121 | Do. do. 4½% Cum. Pref. 1—71,106, £3 paid .. | 5 | 4½% | 4½% | 4½% | 5⅜ — 5⅞ | 6⅜ — 5⅞ | 5 11/16 | .. |
| 290,000‡ | Do. do. 4½% 1st Mort. Deb. Stock .. .. | .. | 4½% | 4½% | 4½% | 109 —114 | 10 — 114 | .. | .. |
| 950,000‡ | Do. do. 3½% Mort. Deb. Stock Red .. .. | Stock | 3½% | 3½% | 3½% | 97 — 99 | 97 — 99 | 98¼ | .. |
| 270,000 | Midland Electric Corporation, 4½ % 1st Mort. Deb. .. .. .. | 100 | 4½% | 4½% | 4½% | 99 —101 | 99 —101 | 100 | .. |
| 10,852 | Notting Hill Electric Lighting .. .. .. .. .. | 10 | 6 % | 6 % | 7 % | 14⅛ — 15½ | 14⅛ — 15½ | .. | .. |
| 59,000 | Do. do. 4% 1st Mort. Deb. .. .. .. .. | 100 | 4 % | 4 % | 4 % | 102 —104 xd | 100 —102 xd | .. | .. |
| 40,000 | St. James' and Pall Mall Electric Light, Ord. .. .. .. .. | 5 | 14⅛% | 14⅜% | 14½% | 13⅛ — 14⅛ | 13⅛ — 14⅛ | 14 3/16 | .. |
| 20,000 | Do. do. do. 7 % Pref. 20,081 to 40,080 | 5 | 7 % | 7% | 7 % | 8⅛ — 8⅜ | 8⅛ — 8⅜ | .. | .. |
| 150,000‡ | Do. do. do. 3½% Deb. Stock Red .. | 100 | 3½% | 3½% | 3½% | 98 —100 | 98 —100 | .. | .. |
| 12,000 | Smithfield Markets Electric Supply, Ord. .. .. .. .. | 5 | 4 % | 4 % | 4 % | 2⅝ — 3⅛ | 2⅝ — 3⅛ | .. | .. |
| 50,000 | Do. do. do. 4 % Deb. Stock .. .. | Stock | 4 % | 4 % | 4 % | 79 — 83 | 79 — 83 | .. | .. |
| 65,000 | South London Electricity Supply, Ord. .. .. .. .. .. | 5 | 1½ % | 3 % | 4 % | 3⅜ — 4¼ | 3⅜ — 4¼ | .. | .. |
| 100,000 | South Metropolitan Electric Light and Power Ord. .. .. | 1 | Nil | Nil | Nil | ⅞ — 1 | ⅞ — 1 | .. | .. |
| 50,000 | (*Late Blackheath and Greenwich* 7 % Pref. .. .. | 1 | Nil | 7 % | 7 % | 1⅜ — 1 7/16 | 1⅜ — 1 7/16 | .. | .. |
| 100,000 | *Dist. E.L.Co.*) 4½% 1st Deb. Stock | 100 | 4½% | 4½% | 4½% | 105 —108 xd | 105 —108 xd | .. | .. |
| 80,000 | Urban Electric Supply, Ord. .. .. .. .. .. | 5 | b % | 5 % | 5 % | 4⅛ — 5 1/16xd | 4⅛ — 5 1/16 xd | 5⅛ | 5 3/16 |
| 80,000 | Do. do. 5 % Cum. Pref. .. .. .. .. | 5 | 5 % | 5 % | 5 % | 5 — 5⅛xd | 5 — 5⅛ xd | .. | .. |
| 200,000 | Do. do. 4½% 1st Mort. Deb. Stock Red .. .. | 100 | .. | .. | 4½% | 104 —106 xd | 104 —106 | 1 5⅜ | 105 |
| 110,000 | Westminster Electric Supply, Ord. .. .. .. .. .. | 5 | 12 % | 13½% | 14½% | 12 — 13 | 12 — 13 | 12 13/16 | 12 3/16 |
| 23,151 | Do. do. 5 % Cum. Pref. .. .. .. .. | 5 | 5 % | 5 % | 5 % | 6⅛ — 6⅜ | 6 — 6⅛ | 6⅜ | .. |

Shares not officially quoted :—Mackay Companies, ord., 44¼—44¾. Pref. 76¼—76¾.

*Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid

## ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

| Locality. | Fort-night ended. | Receipts for the fortnight. £ | £* | No. of wks. | Total to date. £ | £* | Miles open. | * |
|---|---|---|---|---|---|---|---|---|
| Aberdeen .. .. | Apr. 8 | 2,234 | — 138 | 45 | 59,625 | + 5,546 | .. | .. |
| †Ayr .. .. .. | ,, 1 | 193 | + 9 | 46 | 13,185 | + 673 | .. | .. |
| Bath .. .. .. | ,, 5 | 1,187 | — 167 | 14 | 7,695 | + 422 | 12½ | .. |
| Birkenhead .. .. | ,, 2 | 2,981 | .. | 52 | 54,065 | .. | 13·5 | .. |
| Blackburn .. .. | .. | .. | .. | .. | .. | .. | 13¾ | .. |
| †Blackpool .. .. | Mar. 30 | 414 | + 77 | 52 | 47,731 | + 6,488 | 8½ | .. |
| ,, —Fleetw'd | Apr. 8 | 514 | — 556 | 14 | 2,789 | — 615 | .. | .. |
| ,, — Lytham | ,, 6 | 364 | — 402 | 23 | 3,152 | .. | 7½ | .. |
| Bolton .. .. | ,, 9 | 3,682 | - 169 | 2 | 2,525 | — 461 | 25 | .. |
| Bournemouth .. | Mar. 29 | 902 | + 163 | 52 | 55,276 | .. | 16·15 | .. |
| †Bradford .. .. | ,, 25 | 8,939 | + 310 | 51 | 222,149 | + 31,363 | 54 | .. |
| †Brighton .. .. | Apr. 9 | 810 | - 169 | 2 | 1,076 | .. | 9½ | .. |
| Bristol .. .. | ,, 7 | 9,120 | —1,270 | .. | .. | .. | .. | .. |
| Brit. Elec. Trac. Co. | | | | | | | | |
| Airdrie .. .. | Mar. 31 | 374 | + 3 | 13 | 2,499 | — 2 | .. | .. |
| Barnsley .. .. | ,, 31 | 325 | — 9 | ,, | 1,967 | + 44 | .. | .. |
| Barrow .. .. | ,, 31 | 407 | + 98 | ,, | 2,400 | + 393 | .. | .. |
| Birmingham (City) | ,, 31 | 11,733 | +1,43 | ,, | 69,399 | + 4,301 | .. | .. |
| Birmingham (Mid.) | ,, 31 | 3,465 | + 665 | ,, | 21,791 | + 2,932 | .. | .. |
| Devonport .. .. | ,, 31 | 894 | - 63 | ,, | 5,500 | - 271 | .. | .. |
| Dudley—Sto'rb'ge | ,, 31 | 1,702 | + 164 | ,, | 9,716 | + 391 | .. | .. |
| Gateshead .. .. | ,, 31 | 1,759 | — 9 | ,, | 11,145 | + 197 | .. | .. |
| Gravesend, N'fleet | ,, 31 | 412 | — 44 | ,, | 2,424 | — 248 | .. | .. |
| Gr'n'k, Pt. Glsgw | ,, 31 | 1,147 | + 238 | ,, | 6,747 | + 935 | .. | .. |
| Hartlepool .. .. | ,, 31 | 512 | — 6 | ,, | 3,113 | + 12 | .. | .. |
| Kidderminster .. | ,, 31 | 200 | — 1 | ,, | 1,172 | — 27 | .. | .. |
| Merthyr .. .. | ,, 31 | 374 | — 30 | ,, | 2,263 | — 151 | .. | .. |
| Metropolitan .. | ,, 31 | 4,500 | + 178 | ,, | 24,977 | + 10,901 | .. | .. |
| Middleton .. .. | ,, 31 | 622 | + 64 | ,, | 3,409 | + 300 | .. | .. |
| Oldham – Ashton | ,, 31 | 1,068 | — 13 | ,, | 6,806 | + 76 | .. | .. |
| Peterborough .. | ,, 31 | 246 | — 11 | ,, | 1,333 | — 78 | .. | .. |
| Poole .. .. | ,, 31 | 523 | + 31 | ,, | 2,864 | — 48 | .. | .. |
| Potteries .. .. | ,, 31 | 8,467 | + 80 | ,, | 21,302 | + 539 | .. | .. |
| Rothesay .. .. | ,, 31 | 102 | — 5 | ,, | 582 | + 33 | .. | .. |
| Sheerness .. .. | ,, 29 | 126 | + 35 | ,, | 704 | + 140 | .. | .. |
| Southport .. .. | ,, 31 | 527 | — 10 | ,, | 2,974 | - 50 | .. | .. |
| South Staffs. .. | ,, 31 | 1,401 | + 21 | ,, | 8,353 | — 411 | .. | .. |
| Swansea .. .. | ,, 31 | 977 | + 9 | ,, | 5,960 | + 185 | .. | .. |
| Taunton .. .. | ,, 31 | 90 | + 2 | ,, | 522 | — 55 | .. | .. |
| Tynemouth .. .. | ,, 31 | 883 | — 79 | ,, | 2,234 | — 190 | .. | .. |
| Weston-s-Mare .. | ,, 29 | 79 | + 21 | ,, | 365 | + 62 | .. | .. |
| Wolverhampton D. | ,, 31 | 733 | + 18 | ,, | 4,415 | + 208 | .. | .. |
| Worcester .. .. | ,, 31 | 571 | + 86 | ,, | 3,281 | + 821 | .. | .. |
| Wrexham .. .. | ,, 32 | 199 | — 17 | ,, | 1,204 | — 41 | .. | .. |
| Yorks. Wool. Dist. | ,, 31 | 1,283 | + 162 | ,, | 7,231 | + 927 | .. | .. |
| Burnley .. .. | Apr. 8 | 2,226 | + 22 | .. | .. | .. | .. | .. |
| †Burton-on Trent .. | ,, 2 | 305 | — 34 | 52 | 17,420 | .. | 8¼ | .. |
| Bury .. .. .. | .. | .. | .. | .. | .. | .. | .. | .. |

| Locality. | Fort-night ended. | Receipts for the fortnight. £ | £* | No. of wks. | Total to date. £ | £* | Miles open. | * |
|---|---|---|---|---|---|---|---|---|
| †Cardiff .. .. | Mar. 25 | 1,981 | + 115 | 51 | 102,739 | + 2,286 | .. | .. |
| Carlisle .. .. | Apr. 8 | 328 | — 97 | 14 | 2,042 | — 381 | .. | .. |
| Chatham and Dist. | ,, 6 | 1,163 | — 13 | 14 | 8,089 | + 886 | 9·8 | + ·8 |
| Colchester .. .. | ,, 5 | 347 | .. | 36 | 7,843 | .. | 13·75 | .. |
| Cork .. .. .. | ,, 6 | 880 | + 20 | 14 | 5,695 | + 235 | 9·9 | .. |
| Darlington .. .. | ,, 1 | 367 | .. | 44 | 8,567 | .. | 4·87 | .. |
| †Darwen .. .. | Mar. 31 | 227 | — 46 | 52 | 1,748 | — 30 | 4·36 | .. |
| Dundee .. .. | Apr. 5 | 1,621 | — 7 | .. | .. | .. | .. | .. |
| †Dover .. .. | Mar. 25 | 173 | + 5 | 12 | 1,996 | — 14 | 3 | .. |
| Dublin .. .. | Apr. 7 | 8,9 5 | — 124 | .. | 61,460 | + 921 | 18 | + 1 |
| †East Ham .. .. | ,, 1 | 744 | + 26 | 52 | 36,804 | + 2,226 | .. | .. |
| Glasgow .. .. | ,, 8 | 19,867 | +2,410 | 44½ | 640,783 | +34,087 | 78½ | + 4 |
| †Gloucester .. .. | Mar. 29 | 244 | .. | 47 | 13,448 | .. | 15 | .. |
| †Halifax .. .. | ,, 29 | 1,5 0 | — 248 | 52 | 73,969 | + 5,788 | 3 ½ | + ½ |
| †Huddersfield .. | Apr. 8 | 1,223 | — 328 | 1 | .. | .. | .. | .. |
| †Hull .. .. .. | ,, 1 | 2,211 | + 67 | 52 | 113,402 | +11,739 | 13 | .. |
| †Ilford .. .. | Feb. 25 | 316 | + 9 | 47½ | 20,845 | + 1,050 | .. | .. |
| †Ilkeston .. .. | Mar. 29 | 116 | — 1 | 52 | 6,769 | — 597 | 3 ℄ | .. |
| †Ipswich .. .. | Apr. 1 | 372 | — 63 | 52 | 23,411 | .. | 10½ | .. |
| Isle of Thanet .. | ,, 8 | 687 | — 401 | 14 | 3,564 | — 185 | .. | .. |
| Kirkcaldy .. .. | ,, 5 | 440 | + 12 | .. | .. | .. | .. | .. |
| Lan'kshire Trm. Co. | ,, 6 | 1,261 | + 86 | 14 | 8,803 | + 774 | 8·61 | .. |
| Leeds .. .. .. | ,, 8 | 5,476 | — 709 | 2 | 10,947 | + 651 | 8½ | + ½ |
| †Leicester .. .. | ,, 1 | 1,914 | .. | 13 | 23,451 | .. | .. | .. |
| Liverpool .. .. | ,, 1 | 21,755 | +1,3 6 | 18 | 129,055 | + 5,704 | 108 | .. |
| L.C.C. .. .. | Mar. 26 | 26,725 | +5,6·9 | 51½ | 651,9·7 | +145,871 | 47½ | + ⅞ |
| Lowestoft .. .. | Apr. 8 | 240 | — 91 | .. | .. | .. | .. | .. |
| †Manchester .. .. | ,, 1 | 11,923 | + 370 | 52 | 631,762 | +32,444 | .. | .. |
| Newcastle .. .. | ,, 8 | 7,153 | — 248 | .. | .. | .. | .. | .. |
| †Newport .. .. | ,, 1 | 541 | + 53 | 26 | 13,173 | + 1,810 | 14½ | - 1½ |
| Oldham .. .. | ,, 9 | 3,005 | + 182 | 2 | 3,555 | + 6 6 | 22½ | + 4½ |
| Plymouth .. .. | .. | .. | .. | .. | .. | .. | .. | .. |
| Portsmouth .. .. | Mar. 25 | 3,181 | + 377 | 52 | 94,400 | + 6,874 | 14½ | .. |
| †Reading .. .. | ,, 30 | 562 | — 7 | 52 | 3,6·5 | .. | 13·12 | .. |
| †Rochdale .. .. | Apr. 1 | 473 | + 342 | 54 | 14,196 | + 8,039 | 14·6 | 10·2 |
| Salford .. .. | ,, 3 | 7,966 | — 98 | 52 | 209,414 | +11,103 | 80 | .. |
| †Scarborough .. | ,, 1 | 73 | .. | 12 | 507 | .. | 3 | .. |
| Sheffield .. .. | ,, 9 | 9,315 | + 57 | 2 | 9,749 | — 946 | 94½ | + 1½ |
| Southampton .. | Mar. 19 | 1,718 | + 27 | 52 | 49,106 | — 2,687 | 16·6 | .. |
| †Southend-on-Sea .. | ,, 29 | 257 | + 46 | 52 | 17,8·8 | + 1,711 | 6½ | .. |
| †Stockport .. .. | ,, 31 | 487 | — 86 | 52 | 27,794 | + 8,814 | 11½ | + 1 |
| †Sunderland .. .. | ,, 29 | 1,144 | + 80 | 50 | 62,4·5 | + 1,476 | 21 | + 1 |
| Tyneside .. .. | Apr. 5 | 709 | + 20 | 14 | 4,636 | — 610 | .. | .. |
| Warrington .. .. | Mar. 30 | 633 | + 22 | 52 | 16,559 | + 658 | 7½ | .. |
| †West Ham .. .. | ,, 30 | 1,167 | .. | .. | 56,170 | .. | 9 78 | .. |
| †Wolverhampton .. | ,, 29 | 7 9 | + 245 | 52 | 36,548 | .. | .. | .. |
| Cen. London Rly. | Apr. 8 | 14,212 | +1,243 | 14 | 100,365 | + 2,161 | 6 | .. |
| City & S. Lon. Rly. | ,, 9 | 5,501 | — 33 | 15 | 44,402 | — 2,536 | 6½ | .. |
| Dublin-Lucan Rly. | ,, 7 | 205 | — 35 | 14 | 1,337 | — 3 | 7 | .. |
| G. N. and City Rly. | ,, 8 | 3,232 | +1,259 | 14 | 22,488 | .. | 3½ | .. |
| L'pool Overh'd Rly. | ,, 9 | 2,988 | + 219 | 14 | 22,084 | — 1,029 | 6·57 | .. |
| Mersey Railway .. | ,, 8 | 3,165 | — 6 | 14 | 22,244 | + 1,289 | 4½ | .. |

* Compared with the corresponding period of 1904. † One week only. ‡ Includes horse and other receipts.

## ELECTRICITY IN COAL MINES.

The following are the special rules just issued by the Home Office for the installation and use of electricity in coal mines:—

The following rules shall be observed, as far as is reasonably practicable, in the mine.

### Definitions.

The expression "pressure" means the difference of electrical potential between any two conductors through which a supply of energy is given, or between any part of either conductor and earth as read by a hot-wire or electrostatic voltmeter, and

(*a*) Where the conditions of the supply are such that the pressure at the terminals where the electricity is used cannot exceed 250 volts, the supply shall be deemed a low-pressure supply.

(*b*) Where the conditions of supply are such that the pressure at the terminals where the electricity is used, between any two conductors, or between one conductor and earth, may at any time exceed 250 volts, but cannot exceed 650 volts, the supply shall be deemed a medium-pressure supply.

(*c*) Where the conditions of supply are such that the pressure at the terminals where the electricity is used, between any two conductors, or between one conductor and earth, may at any time exceed 650 volts, but cannot exceed 3,000 volts, the supply shall be deemed a high-pressure supply.

(*d*) Where the conditions of supply are such that the pressure at the terminals where the electricity is used, between any two conductors, or between one conductor and earth, may at any time exceed 3,000 volts, the supply shall be deemed an extra high-pressure supply.

### Section I.—General.

1. (*a*) All electrical apparatus and conductors shall be sufficient in size and power for the work they may be called upon to do, and, so far as is reasonably practicable, efficiently covered or safeguarded, and so installed, worked and maintained as to reduce the danger through accidental shock or fire to the minimum, and shall be of such construction, and so worked that the rise in temperature caused by ordinary working will not injure the insulating materials.

(*b*) In any place or part of a mine where General Rule No. 8 of the Coal Mines Regulation Act, 1887, applies, the covering shall be constructed so that, as far as is reasonably practicable, there is no danger of firing gas by sparking or flashing which may occur during the normal or abnormal working of the apparatus.

(*c*) All metallic coverings, armouring of cables, other than trailing cables, and the frames and bedplates of generators, transformers, and motors other than portable motors shall, as far as is reasonably practicable, be efficiently earthed where the pressure at the terminals where the electricity is used exceeds the limits of low pressure.

2. Where a medium-pressure supply is used for power purposes, or for arc lamps in series, the wires or conductors forming the connections to the motors, transformers, arc lamps, or otherwise in connection with the supply, shall be, as far as is reasonably practicable, completely enclosed in strong armouring or metal casing efficiently connected with earth, or they shall be fixed at such a distance apart, or in such a manner, that danger from fire or shock may be reduced to the minimum. This rule shall not apply to trailing cables.

3. Where a medium-pressure supply is used for incandescent lamps in series, the wires or conductors forming connections to the incandescent lamps, or otherwise in connection with the supply, shall be, as far as is reasonably practicable, completely enclosed in strong armouring or metal casing efficiently connected with earth, or they shall be fixed at such a distance apart, or in such a manner that danger from fire or shock shall be reduced to the minimum.

4. Motors of coal-cutting and such other portable machines shall not be used at a pressure higher than medium pressure. No transformer used for supplying current at a pressure higher than medium pressure, and no motor using such current, shall be of less normal rating than 20 B.H.P. for use underground.

No higher pressure than a medium pressure shall be used in any place or part of the mine to which General Rule No. 8 of the Coal Mines Regulation Act, 1887, applies.

5. No higher pressure than a medium-pressure supply shall be used other than for transmission or for motors, and the wires or conductors other than overhead lines above ground forming the connections to the motors or transformers or otherwise in connection with the supply shall be completely enclosed in a strong armouring or metal casing efficiently connected with earth, or they shall be fixed at such a distance apart, or in such a manner that danger from fire or shock shall be reduced to the minimum.

The machines, apparatus, and lines shall be so marked as to clearly indicate that they are high pressure, either by the use of the word "danger" at frequent intervals, or by red paint properly renewed when necessary.

6. The insulation of every complete circuit other than telephone or signal wires used for the supply of energy, including all machinery, apparatus, and devices forming part of or in connection with such circuit, shall be so maintained that the leakage current shall, so far as is reasonably practicable, not exceed $\frac{1}{1000}$ of the maximum supply current, and suitable means shall be provided for the immediate localisation of leakage.

7. In every completely insulated circuit, earth or fault detectors shall be kept connected up in every generating and transforming station, to show immediately any defect in the insulation of the system. The readings of these instruments shall be recorded daily in a book kept at the generating or transforming station or switch-house.

8. Main and distribution switch and fuseboards must be made of incombustible insulating material, such as marble or slate free from metallic veins, and be fixed in as dry a situation as practicable.

9. Every sub-circuit must be protected by a fuse on each pole. Every circuit carrying more than 5 amperes up to 125 volts or 3 amperes at any pressure above 125 volts must be protected in one of the following alternative methods:—

(*a*) By an automatic maximum cut-out on each pole.

(*b*) By a detachable fuse on each pole, constructed in such a manner that it can be removed from a live circuit with the minimum risk of shock.

(*c*) By a switch and fuse on each pole.

10. Fire buckets, filled with clean, dry sand, shall be kept in electrical machine rooms, ready for immediate use in extinguishing fires.

No repair or cleaning of the live parts of any electrical apparatus except mere wiping or oiling shall be done when the current is on.

Gloves, mats, or shoes of india-rubber or other non-conducting material shall be supplied and used where the live parts of switches or machines, working at a pressure exceeding the limits of low pressure, have to be handled for the purpose of adjustment.

11. A competent person shall be on duty at the mine when the electrical apparatus or machinery is in use; and at such time as the amount of electricity delivered down the mine exceeds 200 B.H.P., a competent person shall be on duty at the mine above ground, and another below ground. Every person appointed to work any electric apparatus shall have been instructed in his duty and be competent for the work that he is set to do.

12. No person shall wilfully damage, interfere with, or without proper authority remove or render useless any electric line or any machine, apparatus, or part thereof, used in connection with the supply or use of electricity.

13. Instructions shall be posted up in every generating, transforming, and motor house containing directions as to the restoration of persons suffering from electric shock.

14. Direct telephonic or other equivalent means of communication shall be provided between the surface and the pit bottom or main distributing centre in the pit.

15. Within three months after the introduction into any mine of electric motive power, notice in writing must be sent to H.M. Inspector of Mines for the district. Notice must also be sent of any existing electric motive power installation at any mine within three months after the coming into force of these rules.

16. A plan shall be kept at the mine showing the position of all permanent electrical machinery and cables in the mine, and shall be corrected as often as may be necessary to keep it up to a date not more than three months previously.

### Section II.—Generating Stations and Machine Rooms.

17. Where the generating station under the control of the owner or manager of the mine is not within 400 yards of the working pit mouth, an efficiently enclosed locked switch-box or boxes, or a switch-house, shall, where reasonably practicable, be provided near the pit mouth for cutting off the supply of electricity to the mine.

18. There shall be a passage way in front of the switchboard of not less than 3 ft. in width, and if there are any connections at the back of the switchboard, any passage way behind the switchboard shall not be less than 3 ft. clear. This space shall not be utilised as a storeroom or a lumber room, or obstructed in any manner by resistance frames, meters or otherwise. If space is required for resistance frames or other electrical apparatus behind the board, the passage way must be widened accordingly.

No cable shall cross the passage way at the back of the board except below the floor, or at a height of not less than 7 ft. above the floor.

The space at the back of the switchboards shall be properly floored, accessible from each end, and, except in the case of low-pressure switchboards, must be kept locked up, but the lock must allow of the door being opened from the inside without the use of a key. The floor at the back shall be incombustible, firm and even.

19. Every generator shall be provided with a switch on each pole between the generator and the bus-bars.

Where continuous current generators are paralleled, reverse current cut-outs shall also be provided.

Suitable instruments shall be provided for measuring the current and pressure of each generator.

Every feeder circuit shall at its origin be provided with an ammeter.

20. If the transmission lines from the generating station to the pit are overhead, there shall be lightning arresters in connection with the feeder circuits.

21. Automatic cut-outs must be arranged so that when the contact lever opens outwards no danger exists of striking the head of the attendant. If unenclosed fuses are used they must be placed within 2 ft. of the floor, or be otherwise suitably protected.

When the supply is at a pressure exceeding the limits of medium pressure, there shall be no live metal work on the front of the main switchboard within 8 ft. of the floor or platform, and the space provided under Rule No. 2 of this section shall be not less than 4 ft. in the clear. Insulating floors or mats shall be provided for medium pressure boards where live metal work is on the front or back.

22. All terminals and live metal on machines over medium pressure above ground, and over low pressure under ground, where practicable, shall be protected with insulating covers or with metal covers connected to earth.

23. No person other than an authorised person shall enter a

machine or motor room, nor interfere with the working of any machine, motor, or apparatus connected therewith.

### Section III.—Cables.

24. All conductors (except as hereinafter provided) shall in every case be maintained completely insulated from earth, but it is permissible to use the concentric system with earthed outer conductor, if proper arrangements are made to reduce the danger from fire or shock to the minimum, but the neutral point of polyphase systems and the middle wire of three-wire continuous-current systems may be earthed at one point.

25. Unless fixed as far as is reasonably practicable out of reach of injury, all conductors, other than armoured cables, must further be protected by a suitable covering. Where lead-covered cable is used, the lead shall be earthed, and electrically continuous throughout.

The exposed ends of cables where they enter the terminals of switches, fuses and other appliances must, as far as is reasonably practicable, be properly protected and finished off, so that moisture cannot creep along the insulating material within the waterproof sheath, nor can the insulating material, if of an oily nature, leak out of the cable.

26. All joints must be mechanically and electrically efficient, and, where reasonably practicable, must be suitably soldered. In any place or part of a mine where General Rule No. 8 of the Coal Mines Regulation Act, 1887, applies, suitable joint-boxes must be used, and the conductors connected by means of metal screw clamps, connectors, or their equivalent, constructed in a safe manner. Provided that in any place or part of a mine where a shot may be fired, joints may be soldered by or in the presence of a person authorised in that behalf by the manager, but the same precautions in regard to examination and removal of workmen as are prescribed by paragraphs (*f*) and (*i*) of General Rule 12 shall be observed in all cases, and where the place is dry and dusty, also the precautions as to watering prescribed by paragraph (*h*). Wires, other than signalling wires or cables, must not be joined by merely twisting them together.

27. Overhead bare wires on the surface must be efficiently supported upon insulators, and clear of any traffic, and provided with efficient lightning arresters.

28. All cables used in shafts must be highly insulated and substantially fixed. Shaft cables, not capable of sustaining their own weight, shall be properly supported at intervals varying according to the weight of the cable. Where the cables are not completely boxed in and protected from falling material, space shall be left between them and the side of the shaft, that they may yield and so lessen the blow given by falling material.

29. Where the cables in main haulage roads cannot be kept at least 1 ft. from any part of the tub or tram, they shall be specially protected. When separate cables are used they shall, if reasonably practicable, be fixed on opposite sides of the road.

The fixing with metallic fastenings of cables and wires not provided with metallic covering to walls or timbers is prohibited.

Cables underground when suspended shall be suspended by leather or other flexible material in such a manner as to allow of their readily breaking away when struck, before the cables themselves can be seriously damaged.

Where main or other roads are being repaired, or blasting is being carried out, suitable temporary protection must be used so that the cables are reasonably protected from damage.

30. Trailing cables for portable machines shall be specially flexible, heavily insulated, and protected with either galvanised steel wire armouring, extra stout braiding, hose-pipe, or other effective covering. Trailing cables shall be examined at least once in each shift by the person in charge of the machine, and any defects in them promptly repaired.

At points where the flexible conductors are joined to the main cables, a fixed terminal box must be provided, and a switch shall be fixed close to or in the terminal box capable of entirely cutting off the supply from the terminal box and motor.

### Section IV.—Switches, Fuses and Cut-Outs.

31. Fuses and automatic cut-outs shall be so constructed as effectually to interrupt the current when a short circuit occurs, or when the current through them exceeds the working current by 200 per cent. Fuses shall be stamped or marked, or shall have a label attached, indicating the current with which they are intended to be used, or where fuse wire is used each coil in use shall be so stamped or labelled. Fuses shall only be adjusted or replaced by an authorised person.

32. All live parts of switches, fuses, and cut-outs not in machine rooms, or in compartments specially arranged for the purpose, must be covered. These covers must be of incombustible material, and must be either non-conducting or of rigid metal, and, as far as practicable, clear of all internal mechanism.

33. All points at which a circuit other than those for signals has to be made or broken shall be fitted with proper switches. The use of hooks or other makeshifts is prohibited, and in any place or part of a mine where General Rule No. 8 of the Coal Mines Regulation Act, 1887, applies, the use of open-type switches, fuses, and cut-outs is prohibited; they must either be enclosed in gas-tight boxes, or break under oil.

### Section V.—Motors.

34. All motors, together with their starting resistances, shall be protected by switches capable of entirely cutting off the pressure, and fixed in a convenient position near the motor, and every motor of 10 B.H.P. or over in a machine room underground shall be provided with a suitable ammeter to indicate the load put upon the machine.

35. Where unarmoured cables or wires pass through metal frames or into boxes or motor casings, the holes must be substantially bushed with insulating bushes, and, where necessary, with gas-tight bushings which cannot readily become displaced.

36. Terminal boxes of portable motors must be securely attached to the machine, or be designed to form a part thereof.

37. In any place or part of a mine where General Rule No. 8 of the Coal Mines Regulation Act, 1887, applies, all motors, unless placed in such rooms as are separately ventilated with intake air, shall have all their current-carrying parts, also their starters, terminals, and connections completely enclosed in flame-tight enclosures, made of uninflammable material, and of sufficient strength as not to be liable to be damaged should an explosion of fire-damp occur in the interior, and such enclosures shall not be opened except by an authorised person, and then only when the current is switched off. The pressure shall not be switched on while the enclosures are open.

38. In any place or part of a mine where General Rule No. 8 of the Coal Mines Regulation Act, 1887, applies, a safety lamp or other suitable apparatus for the detection of firedamp shall be provided for use with each machine when working, and should any indication of firedamp appear on the flame of the safety lamp or other apparatus used for the detection of firedamp, the person in charge shall immediately stop the machine, cut off the current at the gate end or nearest switch, and report the matter to an official of the mine.

39. (*a*) A coal-cutter motor shall not be kept continuously at work for a period of time exceeding a maximum period which shall be specified in writing by the manager, so that the roof may be carefully examined.

(*b*) The casing or inspection doors of all portable motors used underground and the casings of their switches and other appliances shall at least once a week be opened by a competent person appointed by the manager, and the parts so disclosed shall be cleaned and examined before the coverings are replaced. In special cases requiring a motor to run continuously longer than one week, the motor shall be examined at the end of the run. A report of such examination shall be entered in a report book.

40. The person in charge of a coal-cutter or drilling machine shall not leave the machine while it is working, and shall, before leaving the working place, see that the current is cut off from the trailing cables. He must not allow the cables to be dragged along by the machine. No repairs shall be made to any portable machine until the pressure has been cut off from the trailing cables.

41. If any electric sparking or arc be produced outside a coal-cutting or other portable motor or by the cables or rails, the machine shall be stopped, and not be worked again until the defect is repaired, and the occurrence shall be reported to an official of the mine.

### Section VI.—Electric Locomotives.

42. Electric haulage by locomotives by the trolley wire system is not permissible in any place or part of a mine where General Rule No. 8 of the Coal Mines Regulation Act, 1887, applies. On this system no pressure exceeding the limits of medium pressure may be employed.

43. In underground roads the trolley wires must be placed so that they are at least 7 ft. above the level of the road or track, or elsewhere, if sufficiently guarded, or the pressure must be cut off from the wires during such hours as the roads are used for travelling on foot in places where trolley wires are fixed. The hours during which travelling on foot is permitted shall be clearly indicated by notices and signals placed in a conspicuous position at the ends of the roads. At other times no one other than a duly authorised person shall be permitted to travel on foot along the road.

On this system either insulated returns or uninsulated metallic returns of low resistance may be employed.

44. In order to prevent any other part of the system being earthed (except when the concentric system with earthed outer conductor is used) the current supplied for use on the trolley wires with an uninsulated return shall be generated by a separate machine, and shall not be taken from or be in connection with electric lines otherwise completely insulated from earth.

45. If storage battery locomotives are used in any place or part of a mine where General Rule No. 8 of the Coal Mines Regulation Act, 1887, applies, the rules applying to motors in such places shall also be deemed to apply to the boxes containing the cells.

### Section VII.—Electric Lighting.

46. All arc lamps shall be so guarded as to prevent pieces of ignited carbon falling from them, and shall not be used in situations where there is likely to be danger from the presence of coaldust. They should be so screened as to prevent risk of contact with persons.

47. Small wires for lighting circuits must be either conveyed in pipes or casings, or suspended from porcelain insulators, or tied to them with some non-conducting material which will not cut the covering, and so that they do not touch any timbering or metal work. On no account must staples be used. If metallic pipes are used, they must be electrically continuous and earthed. If separate uncased wires are used, they must be kept at least 2 in. apart, and not brought together except at lamps or switches or fittings.

48. In any place or part of a mine where General Rule No. 8 of the Coal Mines Regulation Act, 1887, applies, electrical lamps, if used, must be of the vacuum or enclosed type; they shall be protected by gas-tight fittings of strong glass, and have no flexible cord connections, and shall only be changed by a duly authorised competent person. While the lamps are being changed the current shall be switched off.

49. In all machine rooms and other places underground, where a failure of electric light is likely to cause danger, some safety lamps or other proper lights shall be kept for use in the event of such failure.

### Section VIII.—Shot-Firing.

50. Electricity from lighting or power cables shall not be used for firing shots, except in sinking shafts or stone drifts, and then only when a special firing plug, button or switch is provided, which plug, button or switch shall be placed in a fixed locked box, and shall only be accessible to the authorised shot-firer.

The firing cables or wires shall not be connected to this box until immediately before it is required for the firing of shots, and shall be disconnected immediately after the shots are fired.

When shot-firing cables or wires are used in the vicinity of power or lighting cables, sufficient precautions shall be taken to prevent the shot-firing cables or wires from coming in contact with the lighting or power cables.

### Section IX.—Signalling.

The foregoing rules shall not apply to telephone, telegraph, and signal wires, to which the rules of this section only shall apply.

51. All proper precautions must be taken to prevent electric signal and telephone wires from coming into contact with other electric conductors, whether insulated or not.

52. Contact makers or push buttons of electric signalling circuits shall be so constructed and placed as to prevent the circuit being accidentally closed.

53. In any place or part of a mine where General Rule No. 8 of the Coal Mines Regulation Act, 1887, applies, bare wires shall not be used for signalling circuits except in haulage roads, and the pressure shall not exceed 15 volts in any one circuit.

### Section X.—Electric Relighting of Safety Lamps.

54. In mines to any place or part of which General Rule No. 8 of the Coal Mines Regulation Act, 1887, applies, when safety lamps are relighted underground by electricity, the manager shall select a suitable station or stations which are not in the return airway, and in which there is not likely to be any accumulation of inflammable gas; and no electric relighting apparatus shall be used in any other place. All electrical relighting apparatus shall be securely locked, so as not to be available for use except by persons authorised by the manager to relight safety lamps, and such persons shall examine all safety lamps brought for relighting before they are re-issued.

### Section XI.—Exemptions and Miscellaneous.

55. Notwithstanding anything contained in these rules, any electrical plant or apparatus installed or in use before the coming into force of these rules may be continued in use, unless an inspector shall otherwise direct, or subject to any conditions affecting safety that he may prescribe.

In case any difference of opinion shall arise between an inspector and an owner under this rule, the same shall be settled as provided in Sec. 42 of the Coal Mines Regulation Act, 1887.

56. Any of the foregoing requirements shall not apply in any case in which exemption is obtained from the Secretary of State, on the ground either of emergency or special circumstances, on such conditions as the Secretary of State may prescribe.

[Copies of these regulations can be obtained from Messrs. Wyman and Sons, Ltd., Fetter Lane, E.C., or from any bookseller.]

## INSTITUTION OF ELECTRICAL ENGINEERS.

### THE MECHANICAL CONSTRUCTION OF STEAM TURBINES AND TURBO-GENERATORS.

By W. J. A. London.

(*Abstract of Paper read at Manchester, on February 28th, 1905.*)

Too much credit cannot be given to the Hon. C. A. Parsons and his staff for their untiring energy in bringing the steam turbine to its present prominent position. Efficiency, maintenance and durability tests have been carried out by independent experts, which clearly prove that the modern steam turbine as regards general efficiency can hold its own with any form of the best reciprocating engine.

The object of the present paper is to briefly deal with some of the difficulties met with in the successful design of steam turbine machinery, hoping that advantage may be gained by the opening of a discussion on this important subject.

Steam turbines are now constructed with vertical and horizontal shafts. The vertical turbine naturally appeals to the engineer at first sight as being the most suitable for high speed, there being no sagging in the shaft (due to its own weight between the bearings). The further claim is made for the vertical engine that it takes up less floor space than does the horizontal design, this saving meaning a lower cost of foundations and smaller engine room. The present designs of the vertical turbine, however, now on the market do not differ to any great extent in superficial floor area from that taken by one or two types of horizontal machines. Against the advantages set forth above of the vertical machine we must put the following disadvantages:—General inaccessibility, and the difficulty met with and time necessary for the withdrawing of, say, the turbine spindle to attend to any repairs that may be necessary. The footstep bearing necessary to support such a rapidly revolving heavy shaft calls for an exceptional design, and should the supporting fluid give out, considerable damage would be done. Auxiliary machinery is necessary for the supply of this supporting fluid, and also a relay connected to an emergency pump. This auxiliary machinery means additional plant to look after, and floor space which must be added to that taken up by the turbine. A further disadvantage of the vertical type is the fact that the heat radiated from the turbine cylinder rises up and heats the generator. The top bearing must be so designed that it is not possible for any oil to leak on to the generator, the effect of this being often very serious. The stuffing box between the turbine and the generator must also be absolutely steam tight, to prevent the possibility of any vapour rising into the generator. None of the above difficulties are met with when the machine is built on a horizontal axis.

Where the foundations provided for turbines are at all elastic, vibrations will be sometimes set up in them, causing a certain amount of inconvenience to inmates of private houses or hotels where turbines are installed. These vibrations can be damped out in the majority of cases by insulating the bed-plate of the machine from the floor by a layer of wood, felt or lead. It sometimes happens, however, that when the vibrations are thus stamped out entirely in the vicinity of the machine, they can be felt in structural steel work some distance away. They are then most probably due to some harmonic action, and can be generally eliminated by slightly altering the speed of the machine or interrupting the wave of vibration in the girder or other structure that is giving the trouble.

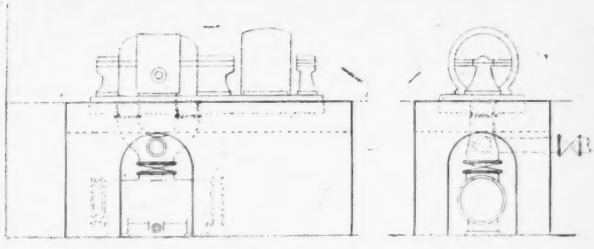


Fig. 1.

In large machines it has been found possible to balance the rotating elements more accurately, and in consequence of the little vibration that is likely to arise, it is preferable to build the bed-plate right into the foundations.

Foundations, where possible, should be of concrete, or brick and cement, and should extend the whole length of the turbine bed-plate. The form of foundation shown in fig. 1 gives good results, and in many cases is the best form for such work. All condensers and auxiliary apparatus can be placed under the turbine, and every part of the plant is easily accessible. Steel or iron constructions in foundations are not to be recommended.

The general principles governing the action of modern steam turbines are well known. The design and construction, however, apart from the actual design of the nozzles, blading, &c., are greatly affected by the governing principles.

In the De Laval the whole of the expansion takes place at one time, the steam being expanded right down to condenser or atmospheric pressure in the one set of nozzles. The velocity obtained is enormous, and consequently high peripheral velocities are necessary in the rotating wheel. In the compound impulse type the expansion takes place in two or more stages of the stationary elements, but no expansion is supposed to take place in the rotating buckets, so that there is no difference of pressure on the two sides of the rotating wheel; this point is important.

The Rateau steam turbine consists of a series of disks mounted on one continuous shaft revolving between stationary diaphragms containing the distributors, which, in reality, are nozzles. This turbine is a multiple De Laval. As all the expansion takes place in the stationary element, there exists no difference of pressure between the two sides of the revolving wheel; thus there is no great tendency for the steam to leak past the periphery of the wheel, and in consequence fine radial clearances between the wheel and casing are not needed. The peripheral velocity adopted is only about 300 ft. per second.

The spindle of each element consists of one throughgoing shaft upon which is mounted a series of forged steel disks, carrying the blades on their outer flanges.

The Zoelly turbine is in principle identical with the Rateau, but the mechanical construction is somewhat different. The revolving disks of the Zoelly turbine run at a much higher peripheral velocity than the Rateau—namely, about 590 ft. per second, so that the number of disks is reduced, and the shaft is much shorter. Even with fewer disks Zoelly divides the machine into two cylinders for the complete expansion, so that the distance between bearings in either cylinder is comparatively short, and the possible troubles due to whipping are greatly reduced. The Hamilton-Holzwarth is another example of this type.

The Curtis turbine in general construction is very similar to the Zoelly. The Rateau and Zoelly turbines expand the steam in each

stationary element, whereas in the Curtis, the expansion which has to be taken care of by two or more wheels, takes place in one expanding nozzle. This system has the effect of reducing the number of rotating blades necessary for a given expansion.

As this machine is very much shorter than the Rateau or Zoelly, it is the opinion of the writer that a turbine on the Curtis principle with a horizontal spindle would present fewer possibilities for trouble than with the vertical spindle.

In the Parsons and Westinghouse turbines a totally different

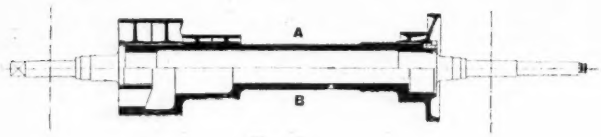



Fig. 2.

general construction to the impulse machines is called for. In these turbines expansion takes place in the revolving blades as well as in the stationary blades. This calls for fine radial clearances. With a drum type of spindle the loss by radial clearance space is somewhat larger than is the case with a disk type, but skin friction is reduced to a minimum, there being no big areas revolving in media of different densities. A spindle of a Parsons turbine is shown in fig. 2B, and consists usually of a cast-steel drum, having forged steel ends shrunk or pressed into it. This form of spindle is much stiffer than a through-going shaft with disks. A certain amount of whipping takes place, however, owing to its great overall length.

Turbines of 1,000 KW. and upwards were, up to a few years ago, divided into two cylinders. It has been proved, however, that it is not necessary to resort to two cylinders; and machines up to 5,000 KW. are now constructed with a single cylinder.

With the Rateau, Zoelly, or Curtis machines, the steam can be concentrated and passed through only a portion of the periphery; but in consequence of the difference of pressure existing between the two sides of the rotating vanes in a Parsons turbine, the whole annulus must be filled with steam, so that small diameters and low velocities have to be resorted to where its density is very high, in order that the percentage of clearance to blade height may not be excessive. As the steam expands, its volume increases, and as the number of rows or blades varies with the square of the velocity, it is advantageous to step up in the diameter of the spindle as soon as possible. Various designs have been tried for these spindles, one type being shown in fig. 2A, which consists of a plain forged steel drum having ends pressed into it of high carbon or nickel steel. The steps are taken care of by a series of cast-steel rings. This type of spindle has the advantage that the forged steel body is more homogeneous than the casting, and consequently is less likely to cause balancing troubles. The cast-steel rings can each be separately balanced and shrunk on. The disadvantage of this type lies in the number of parts, and the amount of machining and fitting necessary, which make this construction more expensive than the first design referred to. Messrs. Parsons now use the type of spindle shown in fig. 2B for all their designs, using cast-steel for the drum. With spindles of this design balancing troubles are often very serious, it being impossible to guarantee absolutely homogeneous material, and on account of the weakest section falling midway between the bearings whipping is likely to occur due to unbalanced mass.

The design of the stationary part of a Parsons turbine is a very important item; as the diameters increase, the greater is the tendency to distortion. The cylinder cannot readily be supported between the bearings, and any irregularity cast on to the part of the cylinder that must remain concentric at once causes distortion. The writer is confident that the majority of accidents due to blades fouling can be traced to the faulty design of this part of the turbine.

The British Westinghouse Co. between two and three years ago, when entering the field of turbine manufacture, arrived at the conclusion that the most successful machine should combine the principles of action and re-action. By making the turbine double flow—that is, by admitting steam in the centre and passing it through equal rows of blades on each side—end thrust and dummies were eliminated.

By adopting a combined impulse wheel to take care of the

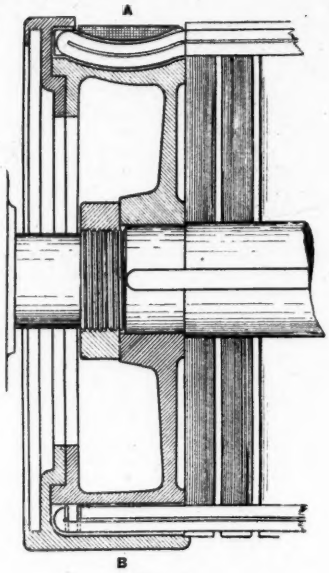



Fig. 4.

expansion from boiler pressure to about 60 lb. abs., it was found that the velocity necessary for the wheel fixed such a diameter that Parsons blading could be successfully used on the one diameter. The result of this combination is that a machine can be built which is very much shorter than the Parsons machine for given conditions, at the same time maintaining the same high degree of efficiency. With this type of machine the skin friction of the disks of the ordinary impulse type is eliminated.

A longitudinal section of a British Westinghouse turbine is shown in fig. 3, and the design as described allows of forged steel being used throughout in the construction of the rotating members. A centre shaft of high carbon steel extends from one bearing to the other, on which is shrunk the disk supporting the drum. The centre disk is of forged steel, and the outer drum is of weldless rolled steel. This drum carries the impulse blades in steel rings, which are shrunk on. The Parsons blading is carried directly in grooves in the main drum. Stiffening disks of thin steel are also fitted into the ends of the drum. A spindle of this construction is extremely stiff, and there are no joints in the spindle likely to give way and cause trouble.

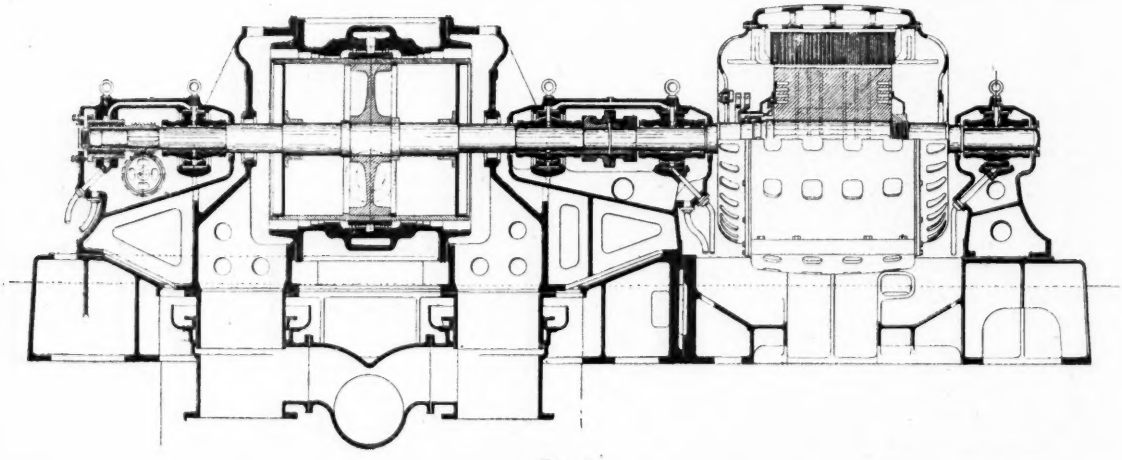


Fig. 3.

The cylinder in the Westinghouse turbine is also much shorter and stiffer than the ordinary Parsons type. Distortion is reduced to a minimum, so that blade fouling is an unlikely occurrence.

The electric generators have to be of special construction for turbine driving. With continuous current generators (for electrical reasons), it is not advisable to have the armature tunnel-wound, but preferably in open slots. This leads to the difficulty of holding the conductors against the centrifugal force attendant upon high speeds. Binding wire is often resorted to, but this construction is a very questionable solution of the problem. The majority of continuous-

current generators to-day are constructed with semi-enclosed slots, a keypiece being driven in on top of the conductors. This construction is satisfactory for the core of the armature, but the end windings require some other method of support. Fig. 4A shows one method of end winding with binding wire. This construction is so designed that where the heaviest load comes on the conductors the thickness of binding wire is greatest. The alternative to the above construction now generally used is shown in fig. 4B, the end winding being kept in position by bronze end bells. This construction has the advantage that repairs can be readily attended to. The greatest difficulty is the securing of suitable material. With cast-bronze it is difficult to ensure the material being homogeneous; and it is advisable, where possible, to use rolled material.

The form of commutator now adopted in nearly all continuous current turbo-generators follows the line shown in fig. 5. The segments are built up with intervening layers of mica and clamped together. The mica is then tied round the outside at the place where the shrink rings are to be fitted; the steel rings are shrunk on and the whole machined inside and out. The commutator is supported on cones at each end, which fit tightly on to the shaft.

Owing to the wear that is bound to take place on such commutators, allowance must be made so that when the commutator is worn down to a certain extent, the segments do not become too weak to support themselves between the rings, and in consequence bulge out, causing high bars. In order that it may become apparent when it is time to stop truing up the commutator, a series of notches or grooves can be placed along the commutator segments indicating the limit for truing up. All overhanging mica, &c., should be turned off, as this has often been found to give trouble by collecting dirt.

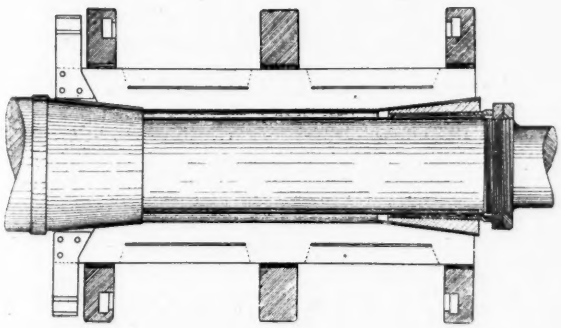


Fig. 5.

The armatures of continuous-current generators can never be of so good a mechanical construction as the turbine spindle, and in consequence balancing troubles are more likely to occur here. Everything throughout should be so designed that when running there is as little unbalanced mass as possible, and where keyways are cut in the shaft, two should be provided diametrically opposite, in order to keep the shaft itself as uniform as possible.

It has been found that it is almost impossible to use carbon brushes on this type of generator, owing to the fact that the armature floats when running, thus causing the brushes to dance; metal brushes must, therefore, always be used. In all modern turbo-generators commutating poles or compensating windings are adopted, thus ensuring the fixed lead.

Continuous current machines are not so applicable, on account of commutation and other difficulties, to this form of prime mover as those for alternating current, where the periodicity is not too low. The first A.C. machine, and those following it for many years, were of the revolving armature type.

During the last few years the demand for larger machines with higher voltages has necessitated the adoption of the rotating field type of alternator. With rotating field machines the design of the armature or stator differs little from that of ordinary slower speed machines. The design of the rotating fields, however, demands very careful consideration. They may be built up of (1) laminated plates, (2) slabs of forged steel, say, about 2 or 3 in. thick, (3) solid core with poles bolted on, (4) one solid piece.

All the above constructions are now adopted by different makers. In large machines the peripheral velocity amounts to something like 300 ft. per second. With this speed centrifugal stresses are very high, demanding the finest material possible for such work.

The British Westinghouse Co., in their designs for the 5,500-KW. turbo alternators for the London Underground Railway Co., in order to be on the absolutely safe side, adopted the solid construction. These rotors run at 1,000 r.p.m. The outside diameter is 67⅝ in., and the peripheral velocity of the pole faces 294 ft. per second. The field itself is a solid forging of Whitworth fluid-compressed steel, the centre being bored out to admit the high carbon steel shaft. The sides of the poles are milled out to admit the windings, ventilating ducts being also milled out.

As in continuous current work, special care must be taken with the winding of the rotors so that the possibility of the shifting of the conductors is reduced to a minimum; and further, owing to the great weight of these rotating fields, the shafts should be as stiff as possible to prevent whipping, which points to another advantage of the solid pole construction, as it materially stiffens the shaft.

In turbo-alternators, while the core and copper losses are slightly smaller than those of the slow-speed type, it is much more difficult to dissipate the heat on account of the much smaller radiating surface. To reduce as low as possible the loss by windage, smooth cores should be adopted where possible. In order to obtain ample ventilation two methods may be adopted:—

1. As much exposed surface and free airway as possible.
2. Machine entirely enclosed, with forced ventilation.

Both these systems are now extensively used, and it is hard to decide which is preferable. The first has the advantage of being more efficient, but has the objection of being noisy. This noise is almost entirely eliminated in the enclosed machine, but tests have shown that with this type, to obtain sufficient ventilation a considerable amount of power is absorbed by the blowers, resulting in a somewhat less efficient machine.

In turbine bearings we are confronted with the following conflicting conditions:—On the one hand the shaft should be sufficiently strong and rigid, necessitating large diameter journals, and the bearings must be sufficiently long to keep the pressure per sq. in. low, to allow of the oil being constantly renewed round the journal. On the other hand, the circumferential speed of the journal must be kept as low as possible to reduce friction. In order to make the whole length of the bearing effective, this length must not be excessive.

Mr. Parsons, during his early experiments, appreciated the fact that a special form of bearing was necessary. He eventually adopted a series of concentric bronze tubes fitting loosely over one another. The spaces between these tubes are filled with oil, making an efficient damper. Considerable vibration may therefore exist at the centre bush without being perceptible at the outer casing.

For small turbines and generators with high speeds down to about 2,000 r.p.m., this bearing is almost universally used, and gives entire satisfaction. For large machines, however, with speeds below that mentioned, the rotating elements can be sufficiently well balanced to run smoothly in solid bearings of cast-iron, white metal lined. Even large bearings must be allowed a certain amount of give, either by easing off the bushes towards the end, or fitting the whole bearing into a spherical seat. As regards the journal itself, the experiments of O. Lasche, of Berlin,* go to prove that the metal employed, whether of nickel steel, Siemens-Martin steel, or mild steel, has little influence on the friction.

The effect of clearance has a marked influence on the efficient working of turbine bearings. In consequence, it is better to ease the bearings considerably on the upper half; this materially decreases the friction, and allows much smoother running. If the shaft is well balanced, the upper half of the bearing can be entirely dispensed with, and this is practically done in many instances, a clearance of $\frac{1}{10}$ in. being allowed on the top half of the bearings. However, instead of cutting the whole of the top of the bearing away, it is safer to allow a strip of the bearing to remain along the top, thus holding the whole shaft.

The peripheral velocity in turbine bearings is necessarily very considerably higher than in ordinary steam engine practice, velocities of 50 ft. per second being regular practice. The load per square inch, however, must be kept very low. In steam turbine practice to-day it is usual to allow a constant of 2,500 for the peripheral velocity in feet per second multiplied by the pressure per square inch on the bearings. This in some cases is raised as high as 3,000. The crux of the whole question is the facility for dissipating the heat, and for this reason as much of the bearing as possible should be in contact with the outer walls, provided, of course, that the outer walls themselves are also free to dissipate heat. Water-cooled bearings are very often resorted to in very large machines, the principal advantage of these being that in a turbine of the Parsons type the water-cooled bearing isolates the heat of the H.P. end of the turbine from the bearing proper. In machines where there is no close contact with steam-heated surfaces, bearings working within the limits mentioned can be run satisfactorily without water cooling. An ample oil supply, however, should be given. The oil leaves the bearings uncontaminated by water or other matter, and can be returned to the cistern and re-used. The usual European practice in turbine work is to allow about ·05 gallon per sq. in. of bearing surface per minute.

Ball bearings are noisy, even with small balls; they are not suitable for high speed work.

Considerable trouble is often experienced in the successful balancing of steam turbines and turbo-generators. To reduce the possibilities of such trouble to a minimum, the following points must be taken into consideration in the design of the machine:—

1. The materials adopted should be as homogeneous as possible.
2. The design should be absolutely symmetrical.
3. Where possible all parts should be machined inside and out.
4. The shaft must be sufficiently stiff to resist undue whipping.
5. Special care must be taken with the windings and insulations to ensure rigidity when running.
6. Where possible the normal running speed should be below the "critical speed." If this is not possible the normal speed should be reasonably higher, so that the critical speed, except when running up or shutting down, is never reached in ordinary operation.

The whole body should be statically balanced before being run. If, however, the drum or body of similar construction shows perfect balance on the knife edges, it is no criterion so far as correct running balance goes.

In balancing, if the rotor is considerably out of balance, one is very often much tempted to apply considerably more weight than

* "Traction and Transmission," Vol. VI., Part 5, p. 33, "On Bearings for High Speeds," by O. Lasche.

is necessary. If the weights are applied at the periphery of the body, which has a velocity of, say, 300 ft. per second at a radius of 1 ft., the actual weight applied is multiplied by the centrifugal force 3,000 times. Very small weights, therefore, have considerable effect in throwing the whole body back into balance.

DISCUSSION.

Mr. MILLER said he would like some information as to the method of fixing the blades and supporting the edges. In a turbine under construction at the British Thomson-Houston Co.'s works the blades were supported on the edges by a gun-metal ring, and were cut out of the solid steel. With regard to the footstep bearing, the trouble caused by the pump failing to act, could be got over by having a hydraulic accumulator. The leakage of steam from stuffing boxes under the generator was not a great difficulty, as the pressure of steam at that point was only about 5 lb.

Mr. BAILIE said that the floor space occupied by vertical and horizontal turbines was about equal when the condenser and pump were taken into consideration. With regard to counteracting vibration, he knew of a case where this was accomplished by inserting two extra joists between the existing joists. He disagreed with the author on the question of building the turbine bed-plate into the foundation. The author vetoed girder foundations, but he had found them perfectly satisfactory, and thought that many people did not build them correctly, neither bracing them nor fitting angle plates. The spindles in Parsons turbines were built of mild steel, which was much to be preferred. The earlier form of turbine was designed with the double flow, but was given up on account of its having lower efficiency than the single flow. He could not recall a case where binding wire had been used on an A.C. armature. He would like to know what the British Westinghouse Co.'s experience was of turbines supplied by them for the Metropolitan Railway.

Mr. WHYSALL said the turbines owned by the Manchester Corporation had been running three years with very satisfactory results. The peripheral speed of the commutator was about 6,000 ft. per minute. Metal brushes were fitted weighing 2 lb. each, and lasting about 336 hours. The commutators had given less trouble than was anticipated, having run 20 months, and only been turned up once. He would like to know what was the highest temperature a white metal bearing would safely work at. With superheated steam he found the oil temperature to be about 150°, and at that temperature it gave no trouble. Water cooling was used. Vibration could be entirely eliminated by balancing.

Mr. SEATON said there were several mills in Lancashire driven by turbines, and also many inquiries for the latter.

Dr. BOWMAN said with regard to the lubrication of the bearings of vertical turbines, he had adopted an accumulator at a large mill in Yorkshire, which had worked very well.

Mr. WALKER stated that the 3,000 KW. turbines built by the British Westinghouse Co. for the Metropolitan Railway had run without a hitch, not one having to be shut down since the start. There was a certain amount of delay in the manufacture which was caused by experimental details. The blades were of such a shape that it was impossible for them to come out.

Mr. AITCHISON did not think that the blades of the Curtis turbine could wipe out, as the blades and guides could not foul one another. On the subject of priming he knew turbines to get rid of the water and then run on satisfactorily; reciprocating sets would not have done so.

Mr. COOPER remarked that he used superheated steam, and when his turbine had been running for two hours, he could not put his hands on the bearings. There was nothing to fear if good oil was used, and the melting point of the metal was not reached or the carbonising point of the oil.

Mr. LONDON, in replying to the discussion, said that blades cut out of the solid looked a better job, but he did not agree that it was so. When blades were put in separately, they could be taken out and repaired, but not so when cut out of the solid. The blades in the Parsons and Westinghouse turbines could not come out except by fouling. There were no mills driven direct off the turbine shafts; they were fitted with a good big reduction gear. On the question of priming, turbines cleared themselves of water, and then ran on all right. Building the bedplate into concrete was a matter of opinion. Personally, he found it gave very good results. The difficulty with the girder foundation was supporting it. There had been no difficulty experienced in the balancing of turbine spindles; what he referred to was balancing the machines. When the machine was considered by the makers as complete there was never any trouble. As pointed out in the discussion, the double-flow machine was given up because of the lower efficiency. He said that the turbines for the London Underground Railway had given a little trouble at first, but they were now running satisfactorily. They could not be tested at the works, and whoever had been the makers, the same thing would have happened. If good oil were used, he did not see why the temperature of the bearings should not go up to 150° or over.

A hearty vote of thanks to the author brought the proceedings to a close.

**Inspectors for Technical Institutes.**—The Council of the Association of Teachers in Technical Institutes has passed the following resolution, and forwarded a copy of it to the Education Authorities:—"In view of the present advertisements for various inspectors for technical institutes generally, we beg to urge that appointments should be given to candidates who have had actual experience as teachers in the technical movement."

## A NEW UNDERGROUND CABLE SYSTEM.

By AXEL HULTMAN, Manager of the Government Telephone Exchange, Stockholm.

THE rapid extension of the telephone early necessitated the placing of subscribers' lines underground, and to-day there is no large modern telephone system without underground cables running out of the central office. Not only town lines, however, have to be laid in this manner, but also the long-distance lines, *i.e.*, the lines between cities, which become numerous in the neighbourhood of important centres, must also be laid in some similar manner, for it becomes impossible to build the ever-increasing pole lines along railways and country roads, especially as these routes are often occupied by power circuits.

The number of long lines in the neighbourhood of Stockholm having become inconveniently large, the Swedish Telegraph Administration began experimenting in 1892 with a cheap mode of running lines, and has continued the experiments ever since.

The capacity of long underground circuits must be kept as low as possible, which involves wide air spaces between conductors, air being the best of all insulating materials. The problem is therefore two-fold—

1. To make the conduit cheap and yet air-tight throughout, and at the same time to afford a complete mechanical protection to the conductors.

2. So to place the conductors in the conduit as to prevent induction and maintain permanently their relative positions.

While experiments have been made with lead-covered paper

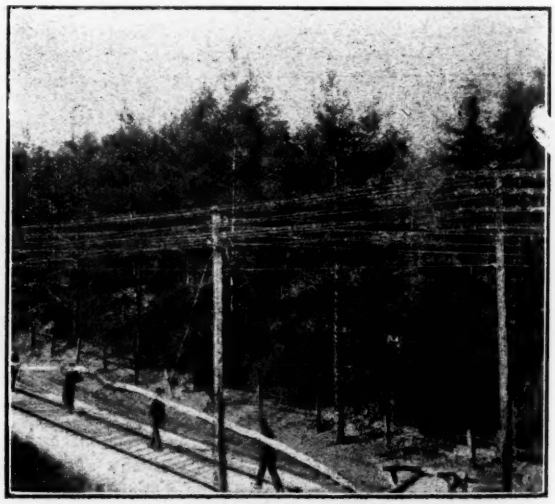


FIG. 1.

cables containing heavy copper wires, spaced as far apart as possible, it is doubtful whether the problem can be solved in this manner at a reasonable cost, for a wide spacing between wires cannot be obtained without an increase of outside diameter and a corresponding increase of cost; then, again, such heavy lead cables are difficult to transport and to lay. On the other hand, in the system which I have succeeded in working out, the conductors can be spaced as far apart as permitted by the limits of cost and room available in each case, and without a considerable increase in the cost of materials, the capacity may be brought down 5 or 10 per cent. under the lowest figures given below. The cables laid hitherto have the conductors of each pair 17 mm. apart, while the distance between pairs is 28 mm., and no conductor is less than 5 mm. from the conduit; this corresponds for 2-mm. conductors to 0·00985 M.F. per km. for the inner conductors, and to 0·0132 M.F. per km. for the outer conductors nearest the conduit.

By increasing these distances to 20, 36·5 and 10 mm. respectively, the capacity is reduced to 0·00935 and 0·0125 M.F. per km. respectively. It is manifest that with such low capacity and with the addition of loading coils underground circuits can be operated over long distances.

Experiments with the system were far enough advanced in November, 1900, to admit of public tests being made and officially certified to.

The first experiments on a large scale were made in 1899 (fig. 1). Owing, however, to various circumstances the first line was not satisfactory. The next experiment on a large scale was made in the spring of 1902 during very bad weather, but the insulation came out at 20 megohms per km., which remained the same in the spring of 1903, thus proving that the protection of the conduit could be relied upon.

This line was laid rapidly, under very unfavourable circumstances, and so near the surface of the ground as to be exposed to the full effect of frost; it was partly laid on hilly and partly on marshy ground.

The conduit is an iron pipe laid in cement, the joints between the lengths being in principle similar to those shown in German patent No. 125,464 (U.S. patent 680,151), although they have now been improved and changed in some respects. The next conduit line was built in the summer of 1903, but the conductors were not drawn in until 1904, and gave 264, 158 and 80 megohms per km. Four wires were bad owing to a fault. Figs. 2 and 3 show the work of laying this line in progress.

During the past winter the conduit laid in 1902 was taken up and carefully examined, the result showing that it had remained throughout in the same condition as when laid.

In order to maintain the wires in place, a variety of disks have been tested; one of these is shown in fig. 4 (U.S. patent 680,151, German patent 126,868). This disk has been changed and improved, but will not be described in detail until new patents are taken out. Experience shows, however, that with the latest devices no contacts either between conductors or between conductors and conduits can take place after the cable has been drawn in and fixed in place. The new system has therefore been tested in every detail, and is now ready for actual use on a large scale.

The mode of construction now used renders these cables more expensive than was expected, but not beyond measure, especially when the low capacity is considered.

A 28-wire conduit and cable, laid down complete, can be made for kr. 5·00 to kr. 5·50 per metre, allowing a reasonable profit. In this price the conductors themselves are not included, as they may vary from 1 to 4 mm. A 76-wire route may be built for kr. 7·50 to kr. 8·00 per metre, and a 148-wire route for 12 to 13 kr. per metre. [The krone is worth about 1s. 1d.] Labour is the principal item of expense, but this is now brought down to a minimum by doing most of the work in the factory. On the ground the work is confined to the trenching, the laying and jointing of the conduit, and the drawing-in of the cable, operations which are simple and are done rapidly by trained men.

The conduits are laid along railways close to the surface of the ground, being covered only sufficiently to prevent interference with railway work. Into this conduit the cable is drawn, being brought from the factory ready provided with insulating disks. The drawing-in is easy, and takes only a few minutes for each section of 300 metres.

The stringing of the wires through the insulating disks is done partly on a machine, and partly by hand. They are arranged exactly in fours, in such a manner as to avoid induction between conductors. This requires certain operations to be performed by hand, but these are reduced to a minimum. This hand labour pays, because it gets twice the number of conductors into the same space as would be occupied by paired wires.

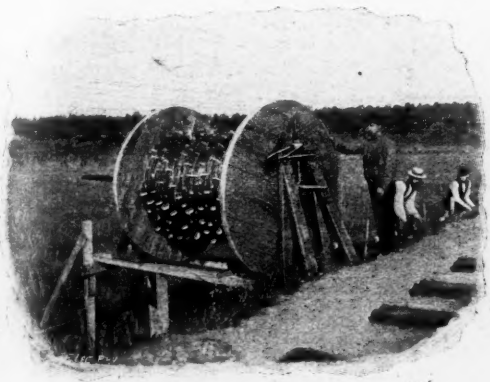


Fig. 2.

Fig. 3.

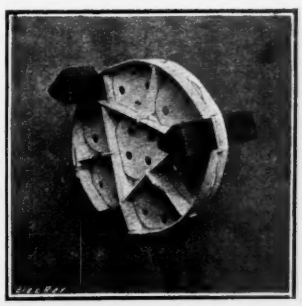


Fig. 4.

## PAYMENT FOR SPECIFICATIONS: THREE POINTS OF VIEW.

By A. LE STRANGE.

*The Architect's.*—In the generic term architect is included the consulting engineer. For certain classes of work there is almost as much competition among architects as among contractors. The mode of obtaining it differs but slightly, and of the two, perhaps, the contractors' method is, on the whole, more open and above-board; still, there is not much to choose.

For small contracts the usual 5 per cent. commission does not pay; but owing to the keen competition a lower fee even than this is sometimes taken; or the fee is inclusive—that is, it must cover all expenses, such as drawings, specifications and any travelling expenses.

Now an architect—still including the consulting engineer—is human; he has animal appetites, and cannot live on air. As soon as he is retained for any work he is beset by temptations. He knows—there is no secret about it—that by specifying So-and-so's window frames, this make of door, and that type of lavatory fittings, grates, &c., a trade commission awaits him, if he deigns to accept it. And, as already mentioned, his appetites are human.

Then there are the office expenses to be considered. Clerks and draughtsmen do not work for nothing. Carbon copies of specifications do not spring from the æther automatically in proportion to the demand, and blues of tracings are not given away by the photo-printer as an advertisement. Who is to pay for all these things? Why should every Dick, Tom and Harry of a contractor be presented with a free copy for the asking of that which has been paid for not only in hard cash but has called for the expenditure of much brain sweat and grey matter?

Let the contractor pay for it, then, if he wants to tender. Could anything appear more reasonable? In the advertisement for tenders, therefore, let it be stipulated that all applications for specifications must be accompanied by 10s., which will not be returned, "to cover cost of plans and printing."

*The Contractor's.*—A contractor secures on the average probably much less than 1 per cent. of the work he tenders for. Each tender costs him money in clerks' wages, office expenses, &c., it entails considerable labour, and often a very

high order of technical ability. All this he looks upon in the form of a speculation and does not complain, so long as he thinks he is getting "a fair show" and he stands an equal chance with the others, and the average number of prizes amounts to, say, 1 per cent. of the blanks, he recognises in a sportsmanlike way that he can't win every time. (And after all, the customer pays as usual; that is, he pays not only for the estimate for his own work, but also for the 99 unproductive ones.) But to ask the contractor to pay for specifications is really more than he can stand.

There is quite a flutter in the electrical contractor's dove-cot just now because an architect has demanded payment for a specification of certain electrical work for one of the co-operative societies. It is an interesting speculation to consider what this architect would have said of a consulting electrical engineer who issued a specification for the building of a co-operative society's premises. Many contractors have asked for their money back, and refused to quote; they have even dared to impose on the architect their opinions on his professional methods; others, again, have written in terms of protest to the co-operative society, who have replied that the matter is beyond their control.

This is all very heroic and very proper; in fact, just what would be expected of a member of that estimable body "The National Electrical Contractors' Association." But there are others, a small minority of those who are not yet within the fold, who look at such things in a very matter of fact, bread-and-butter-philosophy kind of way. Such a one might say to himself, "Oh, 10s. more or less, what matter; if an architect wants it, by all means let him have it. Perhaps he could do with a little more, I must go and see him." Action quickly follows thought, and he does himself the honour of waiting upon the architect—still using the expression in its generic sense—compliments him on the general excellence of the scheme he has drawn up, nothing could possibly be clearer and more straightforward, and so forth, but "there are just one or two small points" he would like a little more light on. Having got the light in exchange say, for a cigar, he may add, quite in an offhand way, "Oh, by the way, Mr. Architect, just to keep myself right—we are both men of the world of course—am I to reserve anything on this—er—for contingencies? As this is our first transaction I thought I had better ask the question. No? Very glad to hear it, Sir. You are quite right, I wish they were all like you. You'll excuse my mentioning it, of course, but I have been bitten once or twice."

This is a crude form of diplomacy that is not at all uncommon in these unregenerate days of cut-throat competition. It may or may not be successful from the contractor's point of view. He risks offending the architect, relying on his knowledge of human character, for the sake of "keeping himself right," that is to say, not letting himself in for a commission for which he has made no provision.

A third, and perhaps more diplomatic method, is frequently adopted, and this is to send in a tender marked net, and to enclose a letter saying that the quotation is subject to a special discount of so and so per cent. This is a very insidious form of temptation, particularly to a young professional man, who finds the struggle for clients very keen and has hard work to make ends meet. It is not so straightforward, if the term straightforward can be applied at all to crooked dealings, as the blunt method of asking a man straight out if there is "anything to be reserved"; yet it leaves a contractor a loophole. He can say the discount was a genuine one and intended for the purchaser.

*The Judge's.*—To deposit a sum varying from 1 to 20 guineas for a specification, pending the sending in of a *bonâ fide* tender, is now quite the recognised custom. As a rule, the deposit is in the form of a cheque, which it is customary to return without its being passed through a bank. Occasionally, however, a Bank of England note is asked for, and contractors are up in arms at once. The advertisement columns of the Review generally contain several "Official Notices," calling for tenders, and almost without exception deposits are asked for. Thus in the issue of April 7th, out of nine notices, seven call for deposits, viz., five for one guinea, one for two guineas, and one for three guineas for each specification. The last-named advertisement calls also for a "further deposit of a £20 Bank of England note" with the tender.

It is generally understood that these deposits are to keep out the small fry, and also to prevent people applying for copies merely out of idle curiosity, people who have no intention whatever of tendering. If such specifications were to be had merely for the asking, a town council would be put to considerable needless expense in printing, and the architects or consulting engineers would have the chagrin of seeing their specifications, embodying probably the results of many years of dearly-bought experience, sent out broadcast to manufacturing firms, contractors, and competitors in their own special department of professional work.

On the face of things there appears to be ample justification for the deposit system.

But, in the light of recent events, more particularly in the light of Mr. Justice Jelf's comments thereon, it is a system which is fraught with very serious possibilities. It appears that the *ex*-Town Clerk of Holborn was in the habit of appropriating the deposits sent in by tenderers, and never returned these unless strongly pressed to do so.

In the course of the trial the following comments were made:—

"Mr. Justice Jelf: How long has this system of deposits been observed?"

"Mr. Muir (for the prosecution): I am told, from time immemorial."

"Mr. Justice Jelf: What is the object of such deposits?"

"Mr. Muir: I understand they are supposed to prevent people sending in frivolous tenders."

"Mr. Justice Jelf (with warmth): It is a most mischievous system, full of danger and temptations, and likely to lead to dishonesty. These contractors knew they could get back their money, yet they left it to fructify, possibly for their own benefit. It is a most insidious form of bribery, full of dishonesty and mischief, and very strongly to be reprobated."

This is a pretty severe denunciation—more severe, perhaps, than necessary. With a proper system of accountancy, and absolutely strict auditing, such a state of things could not occur.

If, on the other hand, the deposits were received by an architect or consultant, he would not need to account to anyone, and a system of bribery and corruption could be very easily carried out if any were to be found sufficiently unscrupulous to do it.

It is to be hoped and believed, however, that the black sheep form a very small minority; but who among the majority will be bold enough to organise a society of professional men who will bind themselves to always do the correct thing; to act up, say, to the code of etiquette laid down by the council of the Institution of Electrical Engineers; to refuse to accept less than an agreed scale of fees, and to boycott any and every contractor and manufacturer who is known to offer bribes or commissions in any shape or form? It would not be a bad thing.

## THE BALLISTIC GALVANOMETER.

By F. ADDEY.

It is well known that the first swing produced on the needle of a ballistic galvanometer, by suddenly turning on a steady current, is double the deflection at which the needle comes to rest, but the proof usually given is somewhat complicated. The following method of demonstrating the fact is simpler:—

Consider the magnetic needle, N S (fig. 1). This has been drawn out of the magnetic meridian A B through an angle $\theta$, and it consequently possesses a certain amount of potential energy due to its position with regard to the earth's field. If it be now released, it will swing back towards the line A B. When it reaches this line, all the potential energy which it possessed while in the position N S will have disappeared, but it will have gained kinetic energy equal in amount to the potential energy it originally possessed. Of course, it is assumed that damping is negligible.

The needle now swings to the other side of the line A B, and is gradually brought to rest by the opposing torque due to the earth's field. When it comes to rest in the position N′ S′, all the kinetic energy it possessed while it was crossing the line A B will have been reconverted into potential energy, and, since there has been no dissipation of

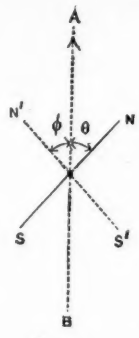



Fig. 1.

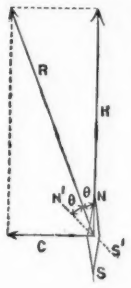



Fig. 2.

energy by friction, the amount of potential energy which it now possesses must be the same as that with which it started. Therefore, since the magnetic field is uniform, it follows that the angle $\varphi$, through which it has moved after crossing the line A B, must be equal to the angle $\theta$ through which it was originally displaced.

Now consider the needle N S of a ballistic galvanometer (fig. 2). This needle is at zero, and is therefore pointing along the controlling field indicated in position and magnitude by H. If a current be started through the coils of the galvanometer, a magnetic field of direction and magnitude C will be set up. The two fields, H and C, will combine to produce the resultant field R. Let the angle between the fields R and H be denoted by $\theta$.

Now at the instant of starting the current the needle is in the position N S, and is, therefore, with reference to the field R, in the same position as the needle in fig. 1 was when it was displaced from the magnetic meridian. Since it is free to move it will swing round, and will reach a position N′ S′, which will be at an angle $\theta$ on the other side of R, as explained above. Thus the total swing will be through an angle 2 $\theta$. When the needle comes to rest it will be pointing along R, or the deflection will then be $\theta$. Thus the first swing is double the steady deflection.

## GERMAN CENTRAL STATIONS.

The *Elektrotechnische Zeitschrift* recently devoted considerable space to the yearly statistics of German central stations, comprising a vast amount of information current up to April, 1904, and an abstract appears in the *American Electrician*. Only those plants are included which sell current to consumers or supply public lighting. There were 51 plants having a capacity of more than 2,000 KW. in 1904. The three largest are in Berlin, and their respective outputs are 85,136, 30,000 and 25,895 KW. The total capacity of the 51 stations of more than 2,000 KW. is 296,693 KW., the stations being in 33 cities. The development of central stations and their connections in Germany in general is shown in the following table:—

| | 1894. | 1900. | 1904. |
|---|---|---|---|
| No. of stations ... ... | 148 | 652 | 1,028 |
| No. of 50-watt incandescent lamps connected ... ... | 493,801 | 2,623,893 | 5,687,382 |
| No. of 10-ampere arc lamps connected ... ... ... | 12,357 | 50,070 | 110,856 |
| H.P. of motors (not including traction) ... ... ... | 5,635 | 106,368 | 263,036 |

In recent years several plants have been erected which supply current to a number of cities and towns in a district; thus the Bruehl central station supplies current for lighting and power to 66 towns at a distance of from 9 to 12 miles from the station. On the other hand, there are some small plants which supply current for power purposes to houses for the support of house industries. A typical example is the Anrath plant near Crefeld. All the motors connected to the mains are in this case between ¼ and ½ H.P., and are used in the silk industry. In recent years the use of power has enormously increased, as is shown in the following table of comparison between the KW. used for lighting and for power, traction motors not being included in the latter case:—

| | Kw. for lighting. | Kw. for power. | No. of motors. |
|---|---|---|---|
| 1885 ... ... ... ... | 250 | — | — |
| 1890 ... ... ... ... | 3,899 | 112 | 28 |
| 1895 ... ... ... ... | 10,752 | 2,252 | 663 |
| 1900 ... ... ... ... | 21 122 | 22,037 | 5,764 |
| 1904 ... ... ... ... | 36,195 | 44,448 | 12,933 |

There is only one plant in Germany which buys energy in bulk from a larger works and sells it in retail to consumers; this is the Spandau station, which gets the current from one of the Berlin works. Statistical data concerning the systems used are given in the following table:—

| | No. of works. | Kw. of machines. | Kw. of batteries. | Total capacity in KW. |
|---|---|---|---|---|
| D.C. with storage batteries .. | 803 | 175,263 | 69,957 | 245,220 |
| D.C. without storage batteries | 40 | 2,346 | — | 2,346 |
| A.C. single-ph. and two-ph .. | 41 | 37 317 | 400 | 37,717 |
| Three-phase current ... | 63 | 69,054 | 1,532 | 70,586 |
| Monocyclic system ... ... | 2 | 1,030 | 152 | 1,182 |
| Mixed three-phase and D.C. | 64 | 141,330 | 23,169 | 164,499 |
| Mixed alternating and D C. | 15 | 8,542 | 855 | 9,397 |

Concerning the power used the statistics show that 570 plants with 341,248 KW. use steam power, 109 plants with 14,547 KW. use water power. 208 plants with 60,672 KW. use both steam and water power, and 94 plants of 10,050 KW. use gas power.

## THREE-PHASE v. CONTINUOUS CURRENTS FOR USE IN MINES.

In a paper read before the Institution of Mining Engineers last year Mr. Roslyn Holiday compared the use of three-phase with continuous currents for mining purposes, and his comparison should prove extremely interesting to mining engineers.

Mr. Holiday strongly advocated the adoption of three-phase currents, which in his own words, "with the exception of charging storage batteries . . . . can be used for any mining purpose to which continuous currents can be applied. For efficiency, simplicity and reliability, the writer is strongly in favour of the three-phase system for use in mines." This statement does not appear to meet with general acceptance by other engineers fully competent to form an opinion upon the question; but, in regard to coal-cutting machines driven by three-phase currents—which Mr. Holiday, in spite of opposition, was the first to introduce in this country—there is unquestionably, from a sparking point of view, much to be said in their favour. Speaking of three-phase coal-cutters, the author said:—"If the motor be sufficiently overloaded, it is pulled out of step, and comes to rest. The writer finds that, if this takes place when coal-cutting, there is a very considerable increase in the flow of current, but that it is not such as almost immediately to burn the motor in the event of the fuses not blowing. In fact, even if the attendant is engaged fixing timber behind the machine when it is pulled up, by the time he has got to it and switched off, there is no perceptible rise in the temperature of the motor. This fact is due to the motor, even when stationary, having by induction a choking effect on the current and so preventing it from rising to dangerous proportions. This feature of three-phase motors is found of the greatest benefit in coal-cutting, for should the cables be short-circuited, the fuses would be instantly blown, but they are not blown every time that the cutter is jammed; in fact, the writer, in his experience, has not known of a single instance of a fuse being blown through this cause. As a consequence he has placed the fuses on the surface only, thus removing from the pit one of the possible sources of danger." Again, in speaking of starting, the author said:—"Up to 30 H.P. these motors can be started without the use of any resistances or other complications . . . . . and this is essential for motors used to drive coal-cutting machines. These motors can also be reversed from full speed in one direction to full speed in the opposite direction, without shutting off the current. This facility of reversal is of great use in coal-cutters of the disk type, as a disk jammed by a piece of cubical coal wedged corner-wise, which would necessitate great power to crush the piece of coal, can be liberated instantly by reversing the motor for a few seconds." These statements, based, as they are, upon actual practical experience, are of the utmost importance, and no doubt will receive the attention they deserve.

It is admitted that three-phase currents are not so suitable for all general purposes, or so efficient as continuous current; but in all mining operations, and especially at the "face," the first principle to be considered is that of *safety*, efficiency only taking a second place; and if this can be attained by the use of three-phase currents with greater certainty and as much reliability, then, by all means, let the three-phase system be adopted, even if this entails the extra expense of putting down plant for transforming, and special cables for three-phase coal-cutting machinery.

One point, however, should be noted. Mr. Holiday's machines are working in seams 5½ ft. in thickness, but the great advantages resulting from the use of coal-cutters are in thin seams of, say, 2 ft., more or less, and for such seams there is a difficulty in designing three-phase motors sufficiently small in diameter, with ordinary

frequencies of 40 to 50. If the frequency can be reduced to about half this amount, the machines may be less in diameter, and, moreover, they will more nearly approach the direct current motor in efficiency and usefulness. For all colliery installations, then, for power purposes it is important to keep the frequency as low as possible in order to secure the best results in the working of the various machines.

## NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

6,400. "Improvements in hangers or ears for overhead electric wires." J. F. Simpson. March 27th.

6,419 "Novel method and means for automatically reversing the direction of a trolley current collector upon an overhead conductor for electric traction systems." B. Smith. March 27th.

6,428. "Improvements in the method of and means for recording the working of engine room telegraphs and engines." J. Bramwell. March 27th.

6,453. "New or improved method and means for measuring electricity with or without recording or registering apparatus and or prepayment mechanism." C. O. Bastian and G. Calvert. March 27th.

6,455. "An improved means for fastening together the ears or clips of overhead electric trolley wires and wires used in conjunction therewith." A. Rogers. March 27th.

6,468. "Process and apparatus for the electric l production of cast-iron, more particularly with a view to the manufacture of steel." Societe Electro-Metallurgique Francaise. (Date applied for under Patents Act, 1901, October 24th, 1904, being date of application in France.) March 27th. (Complete.)

6,469. "Electro-magnetic speed gear for automobile vehicles and boats." Societe en Participation des Automobiles "La Magnetique." (Date applied for under Patents Act, 1901, October 24th, 1904, being date of application in France.) March 27th. (Complete.)

6,523. "Improvements in trolley poles for overhead electric traction." W. Williamson and J. Collinson. March 28th.

6,535. "An electric wire connector." A. J. Ware. March 28th.

6,542. "Improvements in electric light fittings, applicable also for gas, oil and candle light fittings." H. Hirst and F. T. Cash. March 28th.

6,551. "Improvements in the manufacture of troughs and conduits for the distribution of electricity, water, steam, and the like." W. H. Keys and G. H. Shakespeare. March 28th.

6,552. "Improvements in systems of electrical distribution by means of vapour rectifying apparatus." P. C Hewitt. (Date applied for under Patents Act, 1901, April 8th, 1904, being date of applica ion in United States.) March 28th. (Complete.)

6,557. "I provements in apparatus for electric tele; raphs." Siemens Bros. and Co., Ltd., and G. S. Grimston. March 28th

6,567 "Improvements in electric controllers." H. C. Little. March 28th. (Complete.)

6 591. "Improvements in or relating to starting apparatus for electric motors." A. C. Reyrolle and J. Schuil. March 28th.

6,594. "Improvements in insulation for electric heating devices." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) March 28th.

6,595. "Improvements in and relating to dynamo-electric machines." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) March 28th.

6,597. "Improvements in devices for detecting leakage in electric transmission systems." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) March 28th.

6,610. "Improvements in and relating to electricity meters." C. Wilhelm, J. Busch and H. Roosen. March 29th. (Complete.)

6,679. "Improvements connected with electric railways." J. D. Lawson and T. Littlefair. March 29th.

6 681. "Improvements in and relating to electric lighting systems and in apparatus therefor." The British Thomson-H uston Co., Ltd. (The General Electric Co , United States.) March 29th.

6,690 "Improvements in and relating to means for electrically maintaining and reproducing recurring movements particularly applicable to clock movements and time transmission." R. M. Lowne and The Lowne Electric Clock and Appliances Co., Ltd. March 29th.

6,691. "Electric safety apparatus for cars or trains." W. P. Robertson. March 29th. (Date applied for under Patents Act, 1901, May 12th, 1904, being date of application in United States.) (Complete)

6,721. "Collecting gear for alternating current machines, homopolar machines and for conducting electric currents for rotating parts of machinery generally." W. S. Wineler. March 30th.

6,744. "Relay with polarised armature." L. Kamm. March 30th.

6,752. "Improvements in dynamo-electric machines." J. E. Noeggerath. (Date applied for under Patents Act, 1901, March 30th, 1901, being date of application in United States.) March 30th. (Complete.)

6,755. "Improvements in or relating to mercury vapour electric lamps." C. A. Lee. March 30th.

6,760. "Improvements in the electrolytic production of copper wire, strip or the like." S. O. Cowper-Coles. March 30th.

6,775. "Improvements in polyphase current electro-motors." G. Meller. March 30th.

6,790. "Improvements in apparatus for electro-plating." L. Potthoff. March 30th. (Complete)

6,802. "Improvement in automatic electric tramway signals." H. Storm and T. Simpson. March 31st.

6,822. "Improvements in electrical switches." J. H. Tucker. March 31st.

6,834. "An insulation-cutting contact clip." T. B. Reader. March 31st.

6,838. "Improvements in or relating to the suspension of overhead conductors for electrically-operated railways and the like." B. J. Jones. (Date applied for under Patents Act. 1901, April 2nd, 1904, being date of application in United States.) March 31st. (Complete)

6,863. "Improvements in or relating to thermostatic apparatus particularly applicable for actuating fire alarms." C. F. Hilkier. March 31st.

6,865. "Improvements in micro-telephones or instruments containing a telephonic receiver and transmitter in one casing." I. B. Birnbaum. (The Telephon Fabrik Akt.-Ges. vo mals J. Berliner, Austria.) March 31st. (Complete)

6,877 "Improvements in the method of wiring or connecting electric conductors and in patterices, j nction boxes, and the like therefor." H. Bailey. March 31st.

6,872 "Improvements in apparatus for the electrolysis of gases." R. F. Wood-Smith. March 31st.

6,882. "A portable gear-coupled water-motor and dynamo for recharging motor-car electric ignition accumulators and the like." F. J. Matson. April 1st.

6,891. "Improvements in contact-breakers for use in connection with electrically-fired internal-combustion engines." The Electric Ignition Co., Ltd, and F. H. Hall. April 1st.

6,904. "An improved method or arrangement for preventing accident and loss of life through the breakage of overhead electric tramcar wires." G. W. Fowler and G. Hildreth. April 1st.

6,922. "A device for preventing the telephone handle being turned more than once." E. Doye. April 1st.

6,946. "Electric fire alarms." F. Francombe. April 1st.

## PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

### 1904.

Electric Clocks. H. A. Campiche. 3,449. February 11th.

Circuit-Breakers and Indicators for Alternating Currents. L. Andrews 3,460. February 11th.

Method of Fixing the Covers to Electrical Switches and Other Articles. J. H. Tucker. 3,492. February 12th.

Electric Switches. W. Kingsland. 3,547. February 12th.

Alternating Current Motors and Controlling Same. The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) 3,588. February 12th.

Alternating Current Electric Motors. The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) 3,589. February 12th.

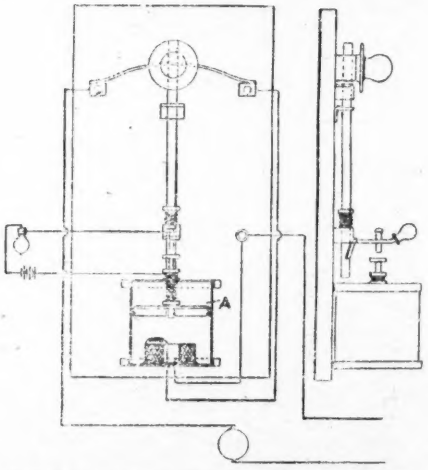
Electric Controlling Apparatus for Electric Circuits. W. Leitner and R. N. Lucas. 3,603. February 12th.

Electric Light Baths and the Like Radiant Therapeutic Appliances. J. Scott. 3,649. February 13th.

Gas or Vapour Electric Lamps. F. W. Le Tall. (Cooper-Hewitt Electric Co.) 3,657. February 13th.

Magneto-Electric Ignition Gear for Internal Combustion Engines. R. Hennig. 3,660. February 18th.

**Time Element Thermal Cut-Out.**—Messrs. Griffith and Biliotti, of 8, John Street, Adelphi, W.C, have recently designed a time element cut-out, which is claimed to embody all the qualities necessary in such a device, and at the same time to be simple, reliable, and to give perfect security to any circuit it is called upon to protect. As the title indicates, it is a thermal device, in which the expansion of a vapour or gas at a given temperature is used to actuate the trigger of a cut-out or other apparatus. The source of heat is a coil connected in series with the apparatus, feeder or circuit, and is so proportioned that the device is affected in the same way as the apparatus it is meant to protect. The diagram shows the small cylinder containing the heating coil and piston, the latter having a vertical piston rod attached. On moving upward the piston rod engages the trip lever, which immediately releases the spring controller switch plunger, the latter being forced upwards and so breaking the circuit. With normal current the cut-out is




Section and Elevation of Thermal Cut-Out.

not affected, but with, say, 25 per cent. overload, it could be so adjusted as to act within a range of 20 minutes to 1 hour; thus adjusted an overload of 50 per cent. will bring it into action within 7 to 20 minutes. The watts lost in the coil varying as the square of the current, and the time required for its action varying inversely as the watts thus dissipated, it can easily be seen that the larger the overload the quicker will be the action of the cut-out. When required, an alarm can be fitted, which will ring a little in advance of the time of action; if, for instance, the cut-out is set to act within 30 minutes with 50 per cent. overload, it will give the alarm after the excess of current has been on for 20 minutes, and with 100 per cent. overload after 5 minutes, the cut-out coming into action 10 and 2½ minutes later on respectively, thus giving sufficient notice to the engineer in charge to prevent a failure in the supply. This cut-out is adapted for both power and lighting purposes; in the former case the time limit obviates difficulties with heavy starting currents, and in the latter a timely alarm can be obtained of an overload approaching the fuse limit.